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THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 20 JANUARY, 1922 No. 1

TWO INTERESTING CASES OF ECTROSYNDACTYLY[1]

By S. E. YAP and E. V. PINEDA

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SIX PLATES

The deformities discussed in this paper consist of ectrodactyly and syndactyly. The former is a defect of the extremities in which there is absence of digits, and the latter is the condition where there is coherence of digits. Both of these malformations were found associated in our two cases.

Ectrosyndactyly is of embryological interest, though it has received but little attention until lately. It is interesting from the viewpoint of its origin and occurrence. Its close resemblance to the claw of the crab or the hoof of some of the ungulates at once attracts the observer's attention. Brief and scattered records of this deformity can be found in the literature of the latter part of the nineteenth century. But there are some cases reported as early as the seventeenth century; such, for instance, as the "Cleppie Bells" family mentioned by Pearson. It is interesting to mention in this connection that the deformity seems to be common in Scotland, where it has been traced in families through from four to six generations. In the majority of cases the defect has occurred in families. Of one hundred eighty cases, collected by Lewis and Embleton in 1907 from the literature, only thirteen occurred as single cases; that is, in various families.

It is unfortunate that we had to base our observations upon only external examination of the extremities and a study of skiagrams. Permission to dissect was refused in Case I, and in Case II, which is still living, it was of course out of the question. The study of skiagrams alone is not sufficient, nor is it entirely satisfactory unless supplemented by actual dissection, for the reason that the shadows are often so indefinite that one cannot always accurately determine union or separation of bones. Moreover, the soft parts blur the image according to the position of the member at the time of the exposure. This is true of the skiagrams of the tarsus in both cases where no definite idea could be gained from the most careful study of the shadows. Hays reports the finding of partial bony union, after actual dissection, which was definitely indicated as separate in the X-ray picture. In judging the size of bones from X-ray pictures alone, we again court error which may cause considerable discrepancy. There was no alternative in our cases, so we had to do the best we could, under the circumstances, by using articulated adult extremities for comparison and control.

---

[1] Read before the annual meeting of the Philippine Islands Medical Association, February 2, 1921.

CASE I

A Filipino woman, aged 35 years, brought to the morgue, having died from accidental burns. She appeared well nourished and showed no deformities other than those of the extremities, the description of which follows:

Right hand.—The right hand shows only three digits: the thumb, the ring finger, and the small finger. The thumb is distorted. It seems to show muscular atrophy, with wrinkling of the skin, and tapers to a point, devoid of nail beyond the bone. The ring and small fingers are syndactylized by the soft tissues at their contiguous margins throughout their entire length. Each is provided with a distinct, apparently normal nail. (Plate 1, fig. 1.)

The carpal bones are distinct and complete in number. The greater and lesser multangulars appear displaced distally and laterally, but otherwise the entire carpus seems normal.

The metacarpals are also complete and distinct. The first seems to have been partially disarticulated from the greater multangular, as apparently indicated by a wide gap between the two and by the direction of the axis of the first metacarpal, being pushed decidedly inward, parallel to the bones of the forearm, instead of diverging outward as it would do normally. The second and third are considerably displaced laterad; the second is somewhat smaller than normal. The fourth and fifth are likewise pushed to the medial side, leaving a triangular space between the third and fourth. The proximal ends of the metacarpals, except that of the second which articulates only with the greater multangular, appear normal in position and connections, while their distal ends or heads show considerable displacement. The head of the second is in contact with that of the first; the heads of the fourth and fifth are also in contact with each other.

The phalanges of the thumb are normal. There are no phalanges in the second metacarpal. The third metacarpal shows only the proximal phalanx considerably lengthened and displaced transversely, wedged in between and articulating with the head of the third and the base of the proximal phalanx of the fourth metacarpal. This phalanx is shaped like a metacarpal, shows evidence of a fracture laterally, and seems to be responsible for the divergence of the third and fourth metacarpals. The phalanges of the fourth and fifth are normal, except for the articulation of the proximal end of the first phalanx of the fourth with the crossed phalanx of the third as mentioned above. (Plate 1, fig. 2.)

Left hand.—The left hand also has three digits, the same as in the right. The ring and small fingers, however, are not syndactylized, and the thumb is apparently normal. (Plate 2, fig. 1.)

The carpals are normal.

The metacarpals are complete and distinct. The first and the fourth are shorter than normal, the second is slenderer and the fifth is larger. The fourth metacarpal curves toward the ulnar side, touches the fifth, and leaves a considerable space between it and the third.

The phalanges of the first metacarpal are normal. The second shows only a rudimentary proximal phalanx, displaced medially. The third has only the proximal phalanx which is bent transversely medially, fusing with the middle of the proximal phalanx of the fourth, and acts as a wedge which pushes the fourth metacarpal toward the ulnar side of the hand. The fourth metacarpal shows a union of the proximal and middle phalanges, the resulting bone being displaced laterally and joined with the proximal phalanx of the third, as mentioned above. The distal phalanx is normal. The last metacarpal also shows a distorted union between its first and middle phalanges, while its distal phalanx is normal. (Plate 2, fig. 2.)

Right foot.—The right foot exhibits only two toes, the great toe and the fifth, each provided with a nail, and with their distal ends curved toward each other like two claws. There is a deep cleft between the two toes extending down to the metatarsal region. The skin shows considerable wrinkling, not unlike the condition observed when a foot has been under water for some time. (Plate 3, fig. 1.)

The bones of the tarsus are apparently normal, except the cuneiform bones, which are so blurred that it is impossible to determine whether there is fusion between them, or between them and the cuboid. (Plate 3, fig. 2.)

Only the first and the fifth metatarsals are present. The former is easily identified by its large size and the latter by its proximal tuberosity. Both bones, as well as their phalanges, are normal. (Plate 3, fig. 3.)

Left foot.—The left foot presents three toes: the great, the fourth, and the fifth, each with a nail. The last two are syndactylized. The great toe is bent laterally and almost touches the fourth. The skin is like that of the other foot. (Plate 4, fig. 1.)

The tarsus is entirely similar to that of the right foot. Only the second metatarsal is absent. The third metatarsal is slenderer and has no phalanges. The first, fourth, and fifth, with their phalanges, are normal. (Plate 4, figs. 2, 3.)

CASE II

Our second case is a well-developed girl, aged 18, admitted to the Philippine General Hospital for some heart complaint.

Right hand.—Aside from a contracted condition of the middle finger and a diminutive supernumerary digit hanging by a narrow stalk from the base of the thumb, this hand is normal.

Right foot.—The right foot has only two toes, the first and the fifth, each provided with its nail, with their distal ends curved toward each other, as in the other case. There is also a deep cleft, extending to the metatarsal region, separating the two toes. (Plate 5, figs. 1, 2.)

The tarsus is apparently normal.

The second and third metatarsals are absent. The fourth is smaller and bent to the left. It has no phalanges. The first and fifth metatarsals, and their phalanges, are normal. Epiphyseal lines are distinct in some of the phalanges. (Plate 5, fig. 3.)

Left foot.—The left foot presents three toes, the great, the fourth, and the fifth, each with a nail and normal in appearance.

There is a Y-shaped cleft, extending to the metatarsal region, between the great and the fourth toes.

The tarsal bones are distinct except the cuneiform bones which do not show clearly in the picture. (Plate 5, figs. 1, 2.)

The metatarsals are all present. All are normal except the second and third; the second is smaller and curves to the right, and the third is slender and is longer due to fusion with the proximal phalanx which is rudimentary.

The phalanges of the first are normal; the second has no phalanges; the third has only the rudimentary proximal phalanx fused with its distal end; the fourth has a longer proximal phalanx and a shorter middle one, while the distal is normal. The phalanges of the last toe are normal except for the absence of the middle one; however, this may be fused with the distal phalanx, the base of which appears rather large. (Plate 6.)

DISCUSSION

In these two cases two interesting facts are prominent. First, that neither woman experienced any inconvenience in the performance of her daily duties; and second, that there is no history of such deformity in the other members of their families.

In this connection it is probably convenient to give a brief review of the embryological development of the skeletal parts of the two human extremities, especially as regards the metacarpals, metatarsals, and phalanges. According to Keibel and Mall and to Minot at about the third week of embryonic life the limb buds appear, formed by the condensation of the mesenchyme into scleroblastema. Between the fifth and sixth weeks, when the embryo has attained 11 millimeters in length, the hand and foot plates are differentiated; the digital rays appear as bars of scleroblastema, but they are not differentiated into metacarpals, metatarsals, and phalanges until the chondrogenous period. Later, chondrification centers appear, those of the metacarpals, metatarsals, and phalanges appearing before those of the carpals and tarsals. By the middle of the third month the cartilages of the hand and foot have acquired the adult shape. Ossification of the shafts of the metacarpals and metatarsals begins at the eighth or ninth week and that of the phalanges at the ninth or tenth week. The epiphyses of the metacarpals and metatarsals ossify from the third to the eighth year, and their union is accomplished at the eighteenth to the twentieth year. Epiphyseal ossification of the phalanges begins from the fourth to the eighth year, and union to the shafts takes place at the nineteenth to the twenty-first year.

In our two cases we found no distinct epiphyseal lines except in some of the phalanges in Case II. This is in accord with the above embryological facts. The discrepancy in our cases from that of normal embryological development of bones lies mainly in the hypoplasia of some of the metacarpals, metatarsals, and phalanges, and in the total absence of some of the metatarsals and phalanges.

It can be deduced from the above considerations that any arrest of the bony development of digits in either extremity must have taken place before the eighth week of embryonic life.

The question of the etiology of these and similar deformities has been ably considered by several authors. The discussions mainly resolve themselves into four theories; namely, the theory of maternal impression, that of external influence, that of atavism, and that of heredity.

Maternal impression.—This theory may be considered only because of its historical value. It is closely linked with superstition, and entirely lacks scientific basis. This is at once apparent if we keep in mind that in most of the cases reported and explained under this theory the impression occurred after the normal period of ossification of these parts.

External influence.—Under this theory many authors include such influencing factors as mechanical agencies, pathological conditions in the ovum or its environment, etc. Of these, the mechanical theory is the most widely discussed. Malformations are explained by internal or external injuries to the embryo while in utero, resulting from such agencies as amniotic adhesions, cord defects, etc. It is probable that many cases of amniotic adhesions result from pressure upon or disease of the amnion. It is a conceivable fact that adhesions between the amnion and the embryo can mechanically prevent or pervert the growth of the parts affected; certainly there are on record cases of digital amputations resulting from adhesive entanglements with the amniotic bands. Moreover, pressure upon an extremity would indeed cause it to be stunted, and such pressure may result from a variety of causes, such as abdominal or uterine tumors, tight lacing, etc.

Cord defects may also be considered as causing amputation of digits, or other similar deformities of the extremities. Some cases of so-called spontaneous amputation have been attributed to them. We can imagine a few cases of ectrosyndactyly as being produced by such factors, but we can hardly say as much of polydactylism.

It cannot be denied that some cases of digital deformity may be explained by the above considerations; but, on the other hand, it would be difficult to account in the same manner for malformation of the extremities observed in amphibia, known to be devoid of amnion, or for those deformities which often occur symmetrically in the two or the four extremities, unless we could conceive of a pressure resulting from some physiological condition.

Furthermore, the occurrence of such defects in families would, even though discontinuous, argue for some hereditary influence working independently of mechanical agencies.

Again, the deformity might also result from anomalous conditions within the ovum itself or in its environmental surroundings, such as deficiency in the germ cell or injury to it resulting from pathological conditions in the uterus at the time when its organs are undergoing development and differentiation. But here again, while we might concede the production of monstrous forms from such causes, we can hardly believe that such general conditions would result in injury localized only in the extremities.

It might be possible to explain these local malformations by defects in local nutrition; as, for instance, syndactyly due to deficiency, and polydactyly resulting from excessive nutrition of the parts. But how are we to explain the incidence in families?

Atavism.—Both polydactyly and ectrosyndactyly have been explained by some writers under the theory of atavism. The intimate association of these two deformities and their extreme difference do not commend dual explanation.

When the theory is applied to syndactyly some writers have in mind the Quadrumana. However, we found no writer who gives a definite statement on the subject or adduces any proof for it. Fotherby considered "the apposition of the great toe to the remaining representatives of digits and the dexterity with which they could be used as a near approach to the Quadrumana." It is the experience of all observers that the deformed never experiences any inconvenience in the performance of his daily tasks; but it does not follow that such dexterity is atavistic.

The argument put forth by some writers against atavism, that they have never seen normal parents give birth to deformed offspring, is answered by Hasselwander's family of brachy- and hypodactyly, and by Wilson's families of polydactyly, where such cases had occurred. But the deformity of the grandparent was never identical to that of the grandchild, which fact again speaks against the theory of atavism.

Finally, the theory falls short if we remember that in these deformities there is great variation in details; no two deformed extremities in the same individual or in any two individuals are found exactly identical, and certainly we agree with Gegenbaur, that it is inconceivable that one extremity has one atavus while the other has another.

Heredity.—Heredity is, in our opinion, a more plausible theory than any of those given above. It explains not only most of the conditions, such as marked tendency to symmetry and quadruplicity, found in these and allied deformities, but also the occurrence in families through several generations.

The occurrence of these deformities in reported single cases, like ours for instance, is not sufficient to overthrow the theory; for in such cases the deformities might have been screened by the families, or these single cases might have been the first to occur in a family some of the descendants of which would be deformed.

The following table shows the strong hereditary tendency of this deformity as well as its allied deformities, brachydactyly and polydactyly. The numbers given in the columns under the different authors mentioned in the title indicate the deformed members in each generation in several families of these family trees, discussed by the authors. It does not include normal families in the same family trees.

The scheme of the transmission of deformity, however, is hard to define. It may be that the deformity determinants are transmitted through the gametes; but, are all gametes carriers of these determinants? Apparently this was not so in the twins of Mayer's family, one of which was deformed while the other was normal; nor in the families of Wilson and of Hasselwander where the deformity escaped one generation in some cases. But this discontinuity may still be explained by conceiving the deformity as made latent in one or two generations by the intervention of other characteristics.

It is, nevertheless, inconceivable that these determinants are invariably transmitted in some fixed form, for it has been shown that no two extremities or individuals had exactly identical deformities; and, as Lewis and Embleton say—

> It seems far more probable that a fundamental factor, which influences the ultimate general confirmation of the affected parts thru their normal representatives, is at fault, that it is transmitted, and that its interaction

TABLE 1.—*Showing hereditary deformities of the extremities.*[a]

Generation.	Ectrosyndactyly. (Split foot and hand.)				Brachydactyly.				Polydactyly.					
										Wilson.				
	Lewis and Embleton.	Fotherby.	Mayer.	Pearson.	Webb.	Wilkie.	Kidd.[b]	Hasselwander.	Windle (Farge.)	Case I.	Case II.	Case III.	Case IV.	Case V.
First		1	1		1	?	1	1	1	1	1	1		1
Second	1	1	6	4	1	2	2	3	1	1	?	5	2	2
Third	11	2	5	11	1	7	1	2	2	3	1	3		1
Fourth	14	9	1	10	5	3	2			2	4	1		
Fifth	17	4			6					2				
Sixth	1				3					1				
Seventh					3									
Total deformed	44	17	13	25	20	12	6	6	4	10	6	10	2	4
Total normal	32	10	6	14	10	4		17	1	39		10	1	

[a] This table includes several families in family trees; normal families are not included.

[b] Ancestors are deformed.

with these representatives varies slightly in quality and quantity in different individuals and generations and that the varying interaction is produced by the interference of factors which may or may not be transmitted, such as those which may be conceived to account for the partial latency.

This hypothesis explains not only the latency and the variation but also the quadruplicity and the symmetry of deformity.

CONCLUSIONS

From the study of our cases and our review of the literature we can endorse the following general conclusions:

1. In the vast majorty of cases the deformity is quadruple.
2. One foot is never malformed alone; the deformity is symmetrical, and similar with individual variations.
3. In the foot the first and fifth toes are the more constantly present. The fifth toe is always present, while the first is in some cases missing.
4. Crossed bones are never found in the feet.
5. The hands are never affected if the feet are not malformed; in a few cases both feet and one hand are deformed.
6. There is generally metacarpal or metatarsal hypoplasia when the phalanges are absent.
7. Ectrodactyly generally affects the second or third toe.
8. Ectrodactyly proceeds from the radial side, avoiding bones as it approaches the ulnar side. In some cases only the little finger is present.
9. Ectrodactyly is less commonly associated with polydactyly than with syndactyly.
10. Syndactyly is generally confined to the fourth and fifth digits of either hands or feet.

ACKNOWLEDGMENTS

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ILLUSTRATIONS

Plate 1, Case I

Fig. 1. Right hand, showing deformity of thumb and absence of index and middle fingers.
2. Right hand, showing bony malformations.

Plate 2, Case I

Fig. 1. Left hand, showing deformities similar to those of right hand.
2. Left hand, showing bony deformities, dorsal view.

Plate 3, Case I

Fig. 1. Right foot, showing absence of second, third, and fourth toes.
2. Right foot, showing relation of carpal bones.
3. Right foot, showing another view.

Plate 4, Case I

Fig. 1. Left foot, showing only three toes.
2. Left foot, showing absence of second metatarsal and second and third toes; dorsolateral view.
3. Left foot, showing normal tarsus; lateral view.

Plate 5, Case II

Fig. 1. Both feet, showing deformity of toes; plantar view.
2. Both feet, showing deformity of toes and condition of skin; dorsal view.
3. Right foot, showing bony deformity of the metatarsus and phalanges; dorsal view.

Plate 6, Case II

Fig. 1. Left foot, showing bony deformity of metatarsals and phalanges; dorsal view.
2. Left foot, showing bony deformity of metatarsus and phalanges; lateral view.

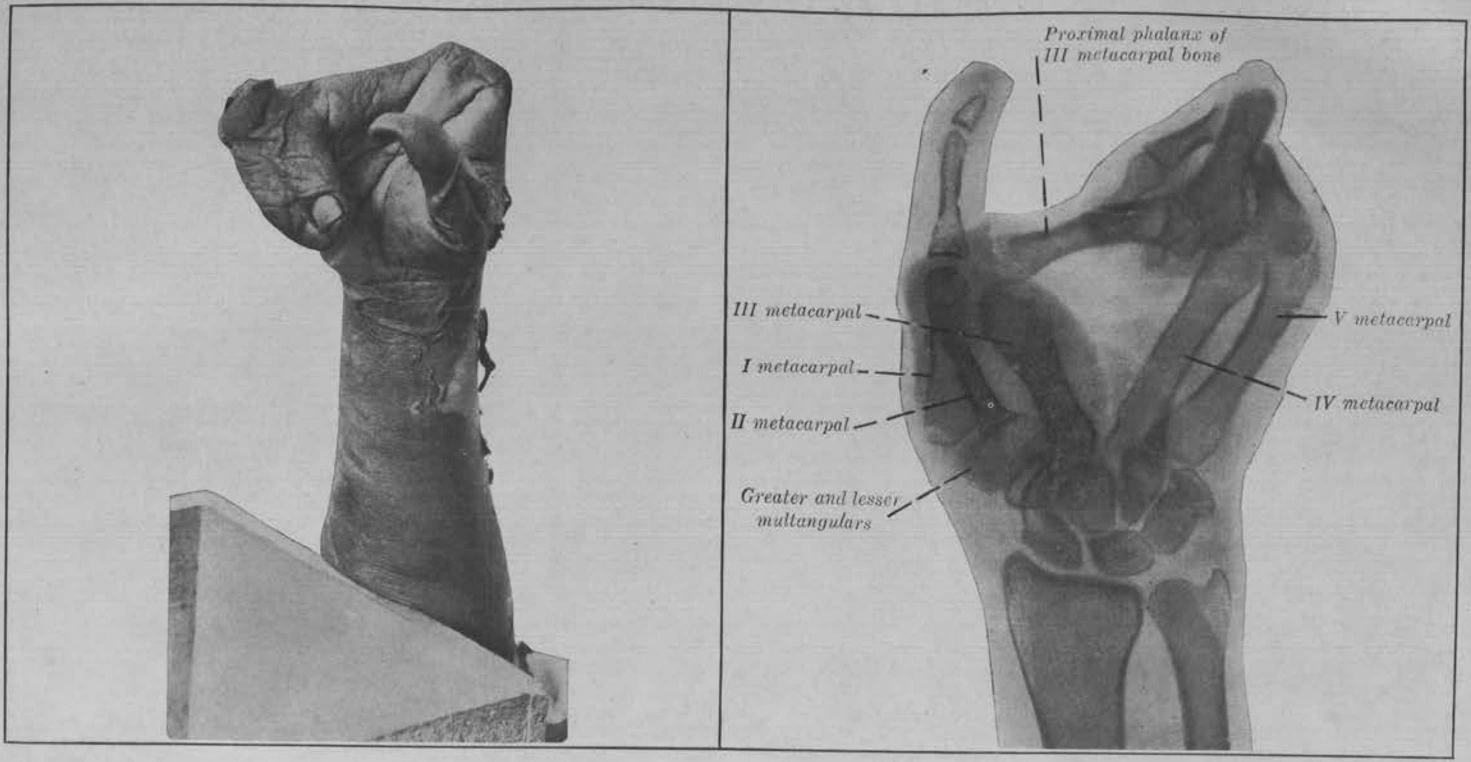

Proximal phalanx of III metacarpal bone
III metacarpal
I metacarpal
II metacarpal
Greater and lesser multangulars
V metacarpal
IV metacarpal

Fig. 1. Fig. 2.

PLATE 1. CASE I. RIGHT HAND.

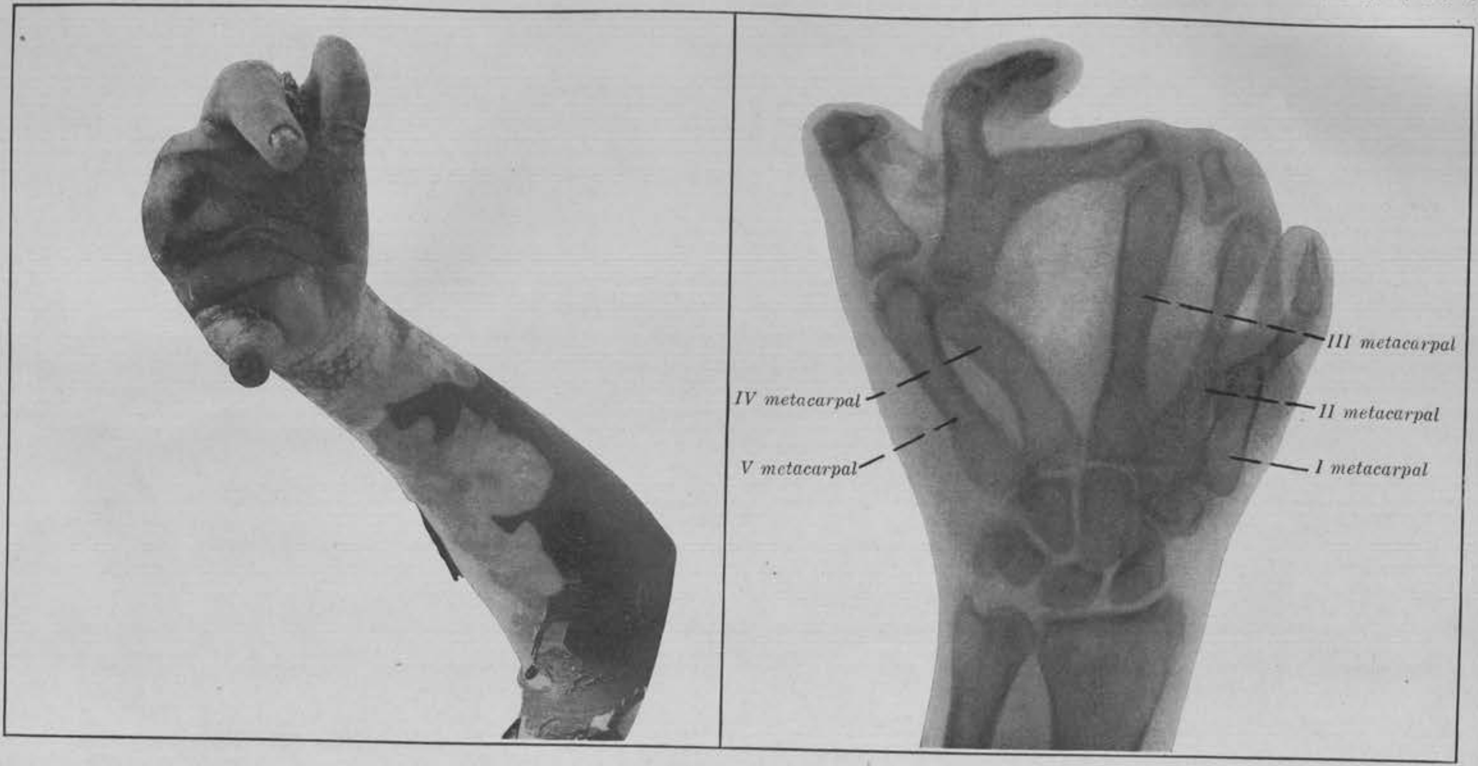


Fig. 1.

Fig. 2.

PLATE 2. CASE I, LEFT HAND.

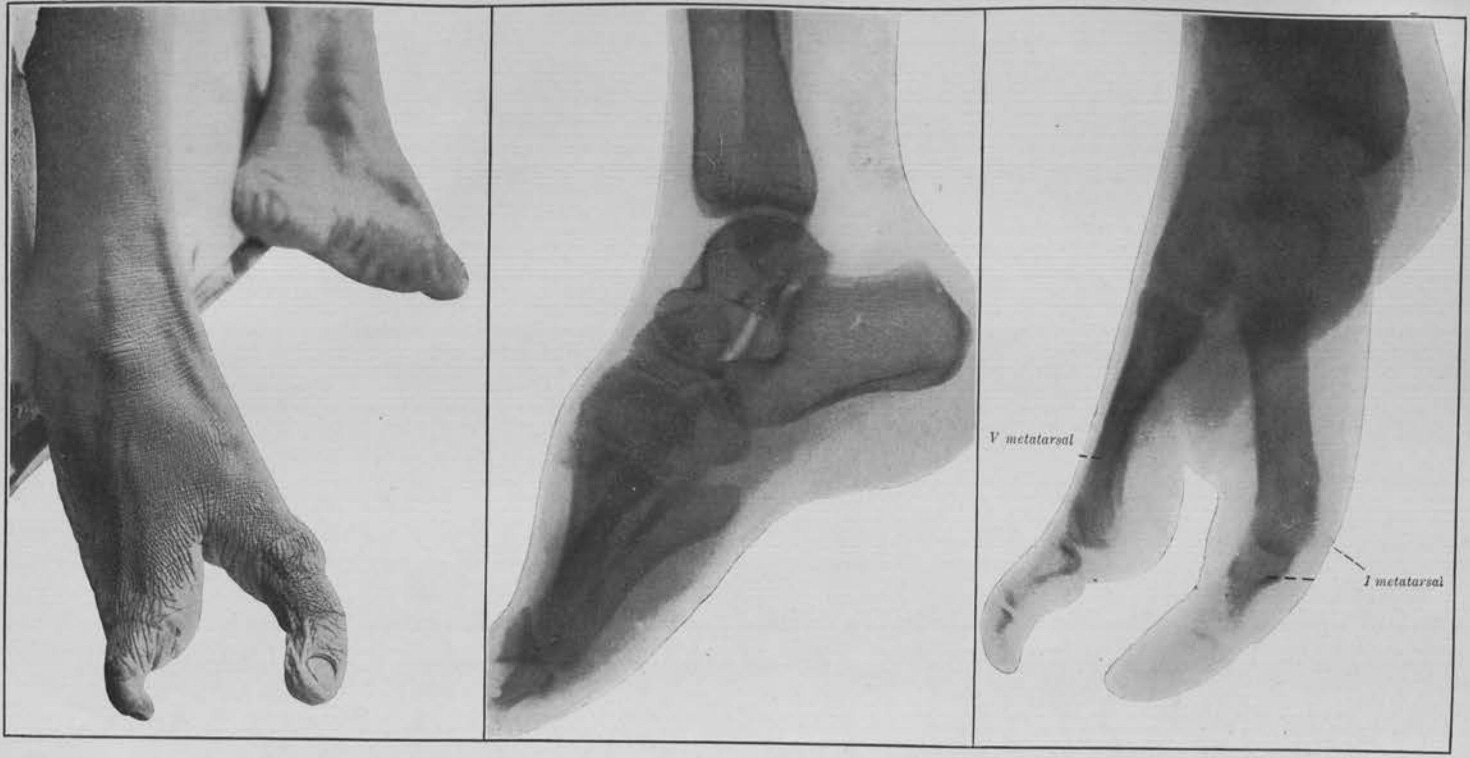


Fig. 1. Fig. 2. Fig. 3.

PLATE 3, CASE I, RIGHT FOOT.

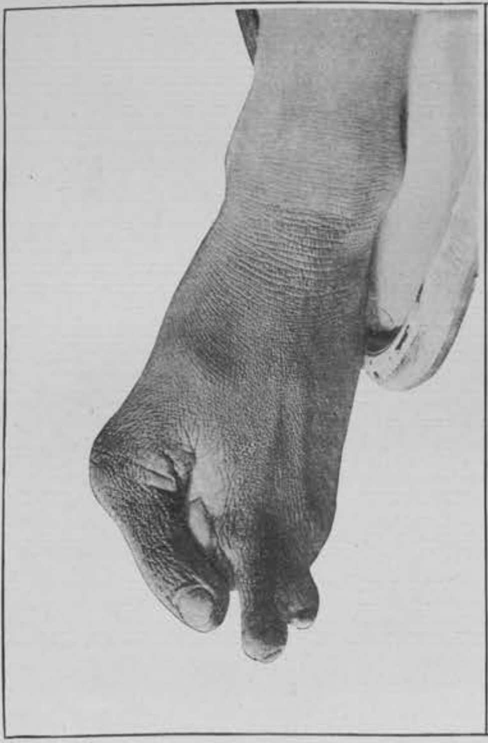


Fig. 1.

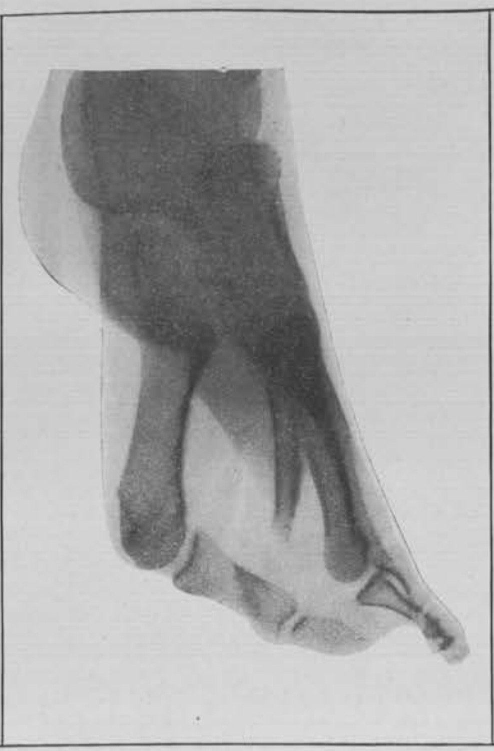


Fig. 2.

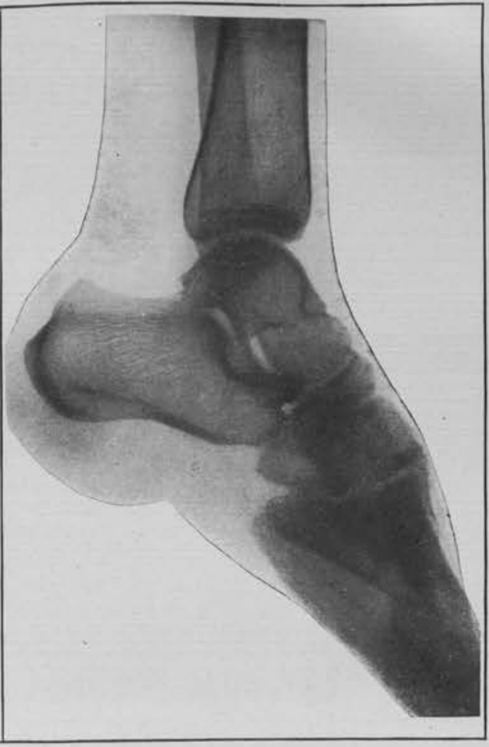
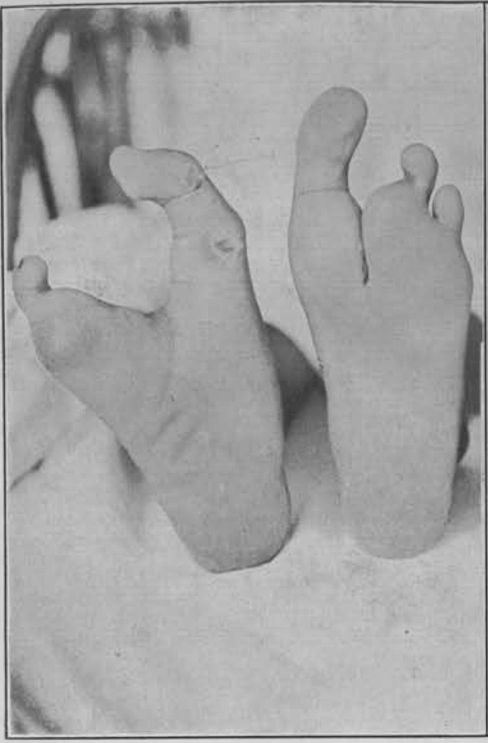


Fig. 3.

PLATE 4, CASE I, LEFT FOOT.



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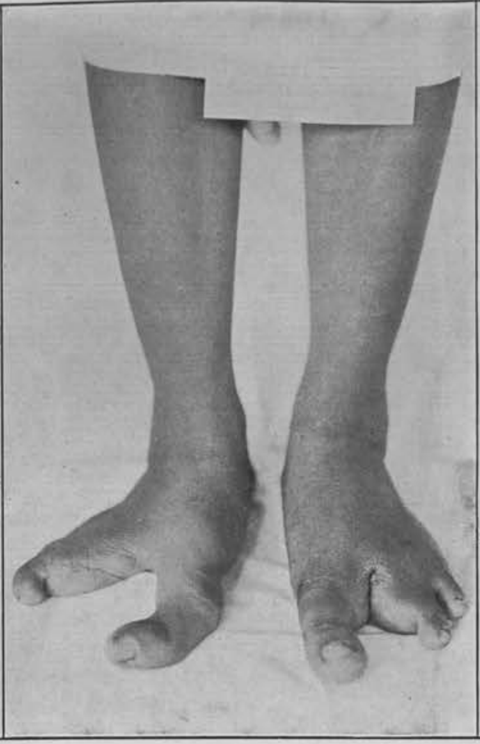

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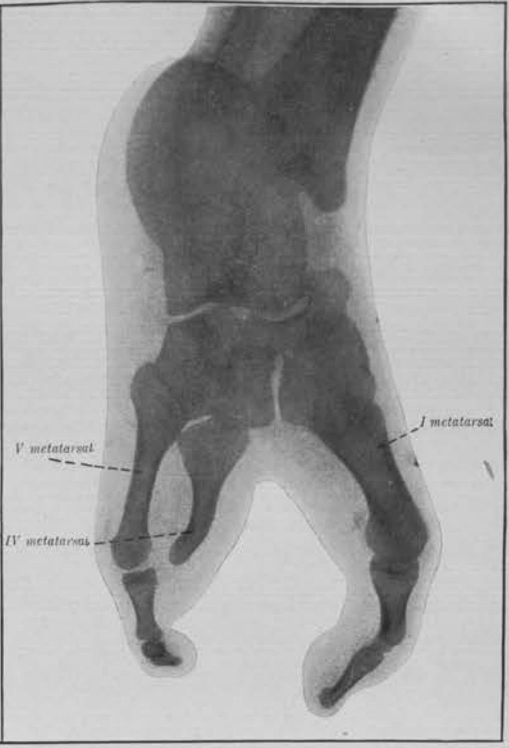

Fig. 3.

PLATE 5, CASE II.

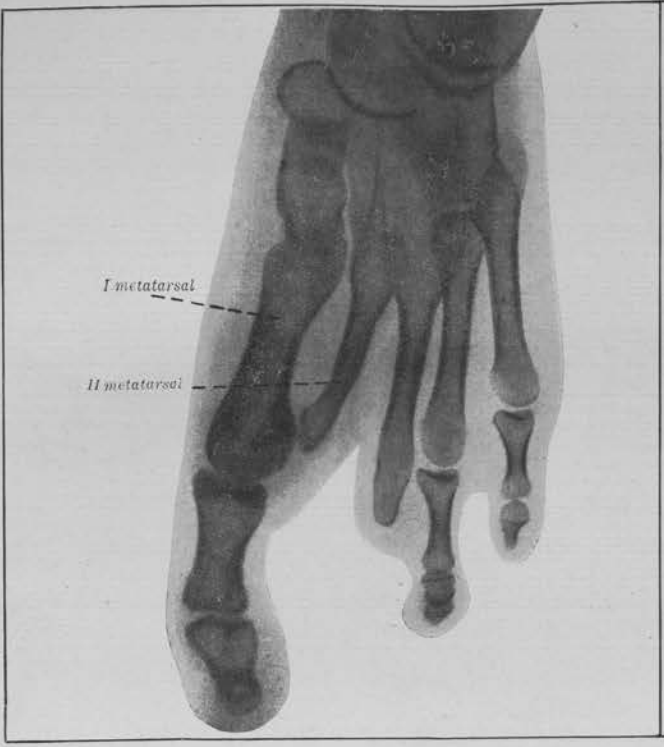

Fig. 1.

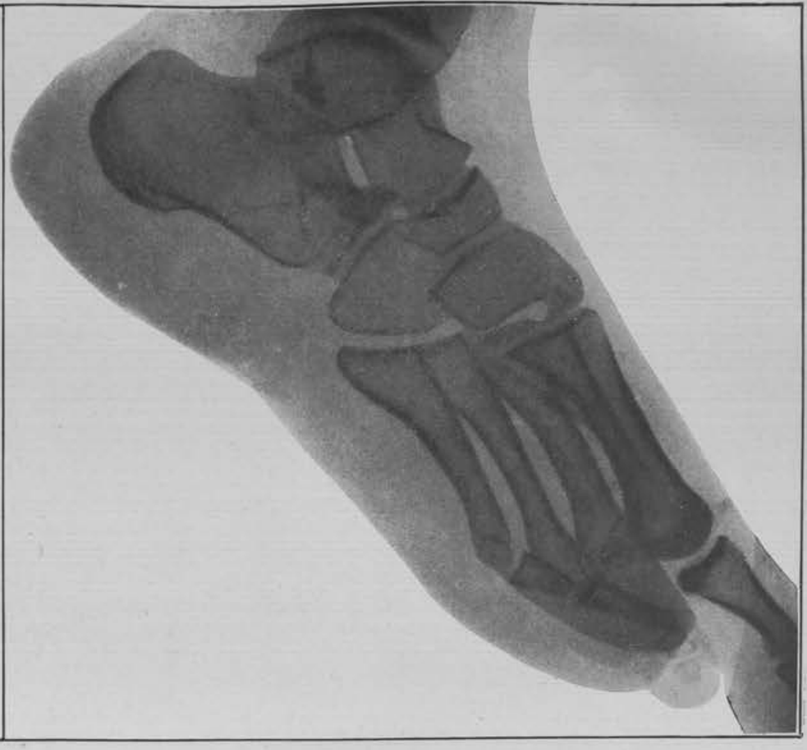

Fig. 2.

PLATE 6, CASE II, LEFT FOOT.

COMMERCIAL ACETYLSALICYLIC ACID [1]

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During the years prior to the World War there were only two factories in Germany which supplied acetylsalicylic acid to the whole world; the Farben-fabriken vorm. F. Bayer, of Leverkusen, whose product was known as aspirin, and the factory of E. Merk, of Darmstadt, where the constitutional chemical name was given to the preparation by the firm and its foreign agencies. Several English patents were issued, which one after another became invalid or void or were protested. A German patent, No. 93110 (June 14, 1896), "Verfahren zur Darstellung von Salicyl-essig-Säure," was granted to Dr. Ludwig Simpach, of Berlin.

When the World War broke out one of the sequels was the deliberate disregard of treaties and patents which ipso facto became "scraps of paper" and, as a consequence, this substance was manufactured in other countries of Europe as well as in North America and Japan. Though the name of aspirin was in most cases preserved, in France the substance prepared in the factories along the Rhone was called Rhodine. The name aspirin is now public property.[2]

The result of such extensive production of aspirin was the manufacture of a large number of preparations under this name or its synonyms, which were placed on the market, though perhaps they do not conform to the requirements of the different pharmacopœias.

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[1] Read at the Philippine Pharmaceutical Convention on January 31, 1921.

[2] Extra Pharmacopœa, by Martindale and Westcott, London.

Note.—The Druggists' Circular 56 (June, 1921) 229 reports that in New York a case was tried before the court, the litigants being the Bayer Company against the United Drug Company. The judge decided that the word "Aspirin" is a trade-mark for manufacturing chemists, retail druggists, and physicians, but not a trade-mark for the public. Accordingly he ruled (April 14, 1921) that packages of 50 or less tablets can be sold to the consumer as aspirin; but packages containing more than 50 tablets (presumably for use by druggists and physicians) of the defendant manufacturer of Acetyl-salicylic acid may not be sold as "Aspirin."

Reviewing the pharmacopœias of several countries we find that the Swiss and Japanese of 1907; the French Codex and Swedish Pharmacopœia of 1908; the Italian and Hungarian of 1909; the German Pharmacopœia of 1910 (its prior edition being in 1900); the Norwegian of 1913, the British Pharmacopœia of 1914, and the Belgian Pharmacopœia in a supplement later than 1906, recognize acetylsalicylic acid as official, and all of them establish its characteristic properties as well as the tests for purity. It is, indeed, striking that the United States Pharmacopœia of 1910 does not list this drug among the official remedies; nor does it appear in the National Formulary. Undoubtedly the new edition of the United States Pharmacopœia will include this drug as an official one.

In examining different specimens of aspirin we are unable to determine a fixed, invariable criterion.

The solubility of acetylsalicylic acid is expressed in almost identical terms in the several pharmacopœias we have at hand. The melting point is fixed at 135° C., more or less, according to the experience of several authors as well as ourselves. The chemical reaction of aspirin should be neutral, but a slight acidity is admissible. The odor is supposed to be negative; the Pharmacopœia Helvetica, however, tolerates a light, vinegarlike odor. Aspirin in hydro-alcoholic solution must show no change toward ferric chloride solution, but the Pharmacopœia of Japan allows a weak violet coloration.

In the study of aspirin it is necessary to consider two kinds of reaction; namely, reactions leading to identification, and those showing its purity. It is clear that the constants and the different tests given in several pharmacopœias are sufficient for recognition or identification of this substance.

The test by the reagent of Tsakalotos, which is nothing but a modification of that of Mendelin,[3] is not conclusive for aspirin, since salicylic acid, salol, and similar compounds show the same result and, at most, it serves only to determine the presence of the salicylic acid radical. The same can be said in regard to the reagent of Kobert.[4]

However, the pharmacist is not primarily interested in the identification of a drug since, generally, this is guaranteed by the wholesale dealer. The purity of a drug is the important feature in which a professional pharmacist is interested. Unfortunately we have no official standards for the purity of aspirin since the United States Pharmacopœia has, so far, set no standards.

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[3] Bull. Sc. Pharm. 25 (1918) 75.

[4] Loc. cit.

With these conditions in mind we worked on the samples we secured from pharmacists and druggists in Manila and here give only our findings, without having formulated definite conclusions.

Table 1 shows the physical characters and constants of eight samples; two imported from Germany, two the product of German factories in America, and four of purely American manufacture.

TABLE 1.—*Physical constants of aspirin.*

Sample.	Appearance.	Color.	Odor.	Melting point.	Ash.
I	Silky needles	Pinkish white	Aromatic vinegarlike	131.5	0.00
II	Crystalline powder	do	Odorless	136	0.00
III	Silky prisms	White	Aromatic	136	0.00
IV	Crystalline powder	do	Vinegarlike	133	0.00
V	Fine needles	do	Aromatic	127	0.040
VI	do	do	Vinegarlike	131	0.059
VII	Crystalline powder	do	Aromatic	131	0.00
VIII	Fine needles	do	do	133	0.00

Discussing the physical constants shown in Table 1, we notice that the melting point of 135° C. given by the Pharmacopœia Germanica does not coincide with the results obtained from the samples examined by us—even with those from Germany. The British Pharmacopœia, however, accepts 133° C.

M. Auerbach, working on samples from three German factories for the Court of Arbitration of the Wholesale Druggists' Association of Hamburg,[5] fixed the melting point at from 132° to 134° C.

An interesting point in this connection is brought out by G. Capelli, of the Chemical Laboratory of the Italian Inspectorate of Military Hygiene. Capelli advances the idea that the melting point of aspirin varies with the solvent used in its crystallization. His results, and those of Hans Meyer, are as follows:

Solvent.	Capelli. °C.	Meyer. °C.
Water	126–129	....
Chloroform	134.2	....
Benzol	134.5	132.7
Carbon tetrachloride	134.5	133.7
Acetone and water	....	128.2
Alcohol and water	....	129.3

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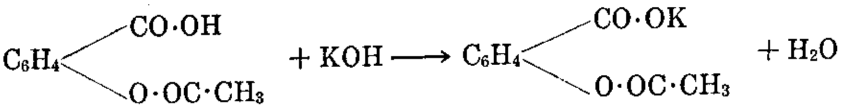
[5] Chemist and Druggist 93 (1920) 1274.

The melting point of samples crystallized in water and aqueous solvents is undoubtedly lower than that of samples for whose crystallization other solvents were used.

Capelli concludes that a melting point of 135° C. is the best index by which to judge the purity of this compound; temperatures of 124° to 130° are not allowed by the pharmacopœias, for it is believed that water retained by the sample induces partial saponification.

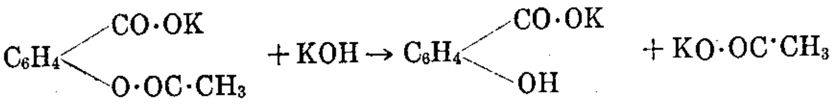
In the samples examined we noted that only the odorless samples (that is to say, those free from any appreciable dissociation) possessed a high melting point, 136° C. The same melting point, moreover, was shown by samples having an aromatic odor which was not related to either acetic or salicylic acid.

The evaluation or the determination of the purity of a sample of aspirin involves two titrations in the presence of phenolphthalein, according to A. Astruc,[6] which will show, first, its acid value and, second, its saponification value, thus:



$$C_6H_4\begin{cases} CO \cdot OH \\ O \cdot OC \cdot CH_3 \end{cases} + KOH \longrightarrow C_6H_4\begin{cases} CO \cdot OK \\ O \cdot OC \cdot CH_3 \end{cases} + H_2O$$

and



$$C_6H_4\begin{cases} CO \cdot OK \\ O \cdot OC \cdot CH_3 \end{cases} + KOH \rightarrow C_6H_4\begin{cases} CO \cdot OK \\ OH \end{cases} + KO \cdot OC \cdot CH_3$$

These two evaluations complete each other because the first titration would be insufficient if used alone since, as Astruc says, if the acetylsalicylic acid were adulterated with a mixture of 76.66 per cent of salicylic acid and 33.33 per cent of neutralized salt, the result would be the same. Accordingly, in our work we determined the acid and saponification values or numbers and, by way of check, we also determined the bromine numbers to identify the salicylic radical in aspirin, which exists as such or under some other form.

Smith[7] assumes that acetylsalicylic acid, being so unstable a compound, may partially undergo molecular rearrangement in se, thus:

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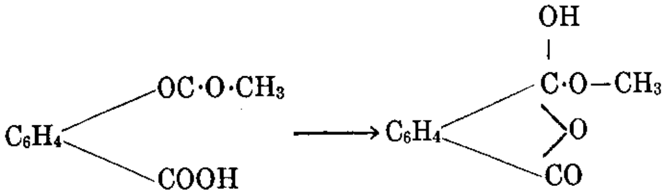
[6] Bull. Sc. Pharm. 25 (1918) 79.

[7] A. Nutter-Smith, Chemist and Druggist 93 (1920) 1038.



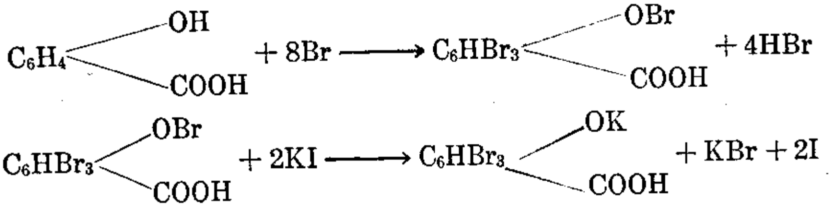
Moreover, in the examination of this wrongly named ester, which is rather a keto-acid, we determined the free acetic and free salicylic acid by methods which, if not accurate, at least give us the ratio among the samples examined.

The methods used by us were:

1. The titration of our group of samples dissolved in 15 cubic centimeters of alcohol rendered neutral with 0.2 *N* sodium hydroxide using phenolphthalein as an indicator.

2. To this neutral solution 50 cubic centimeters excess of 0.2 *N* sodium hydroxide is added, boiled under a reflux condenser for half an hour, and titrated back with 0.2 *N* sulphuric acid. The amount of sodium hydroxide used in both titrations for the acid and the saponification values ought to be the same.

3. The identification of salicylic acid by the bromine test is based upon the fact that four hydrogen atoms are replaced by bromine; of these four bromine atoms only one (that of the chain) and the excess of the solution react upon the potassium iodide solution, thus:



It is, therefore, evident that for each molecule of salicylic acid (molecular weight 138) three atoms of bromine ($3 \times 79.92 = 239.76$) are fixed. The number corresponding to sample 0 in Table 2 (which is theoretical) for the 0.2 *N* bromine solution is calculated for a one-gram sample.

4. As to free acetic acid, we used a method that gives only a relative content of the sample.

The method consists in washing a gram of the sample on a plain filter with small portions of distilled water at 15° C., up to a total of 25 cubic centimeters. The filtrate is then titrated with 0.2 *N* sodium hydroxide.

We have not used the aspiration method of Smith,[8] for it is very slow and we have not succeeded in getting good results by it.

5. The free salicylic acid was determined colorimetrically, applying a method based on the tests given by several pharmacopœias. These state that 0.1 gram of aspirin dissolved in 5 cubic centimeters of alcohol and 20 cubic centimeters of water must give no color with ferric chloride solution. The Pharmacopœia of Japan allows a light coloration in this test, which indicates that under local climatic conditions the best samples undergo partial dissociation.

A similar procedure was adopted in our experiment. Using solutions of salicylic acid of different concentrations and performing the test under identical conditions we compared the coloration in Nessler tubes.

In this way the results in the eighth column of Table 2 were obtained.

TABLE 2.—*Chemical constants of aspirin.*

Sample, 1 gram.	Acidic value.		Saturation value.		Bromine number.		Free acids.	
	0.2 *N* sodium hydroxide.	Corresponding salicylic acid.	0.2 *N* sodium hydroxide.	Corresponding acetic acid.	0.2 *N* bromine.	Corresponding salicylic acid.	Acetic.	Salicylic.
	cc.		*cc.*		*cc.*			
0	27.77	0.7666	27.77	0.3333	83.815	0.7666	0.000	0.000
I	28.12	0.7761	27.17	0.3261	72.90	0.6706	0.018	0.015
II	27.75	0.7659	26.96	0.3235	67.08	0.6171	0.016	0.007
III	27.92	0.7706	27.10	0.3252	65.19	0.6007	0.016	0.011
IV	27.57	0.7609	27.60	0.3312	75.00	0.6900	0.018	0.002
V	27.59	0.7615	28.26	0.3391	66.69	0.6135	0.019	0.008
VI	27.77	0.7666	26.26	0.3151	78.84	0.7251	0.011	0.005
VII	27.40	0.7562	28.13	0.3375	74.43	0.6847	0.026	0.011
VIII	28.77	0.7940	27.76	0.3331	79.23	0.7289	0.013	0.002

On analyzing the figures set forth in Table 2 it becomes apparent that certain samples, such as I and VIII, give a figure for acidity that is higher than the theoretical figures, and that Samples V and VII show the same peculiarity in respect of the saturation value. Impressed by these facts we checked the figures several times and found no reason to amend them.

We may say that in the table published by Jones we notice the same anomalies in several of his samples. As to the explanation of this we venture the hypothesis, put forward by B. Baker,[9] that the more or less advanced hydrolysis and the amount of free acids are the reasons for such abnormality.

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[8] Op. cit. 1037.

STANDARD QUALITIES

As a result of our experiments we hesitate to draw any conclusions, for we realize that the climatic conditions of our country are perhaps responsible for the deviation of the constants of the samples, even in those considered as the best.

As to the melting point, Jones[10] says that 136° C. is the temperature shown by samples of stable constitution, and any melting point lower than 135° C. (that required by several pharmacopœias) must not be accepted, for samples which have caused some trouble following administration to human beings have invariably showed the melting point to be below 133° C. In discussing the figures obtained by him in regard to acid and ester content the same author says:[10]

> The question now remains as to what analytical figures may be considered characteristic of the best grades on the market, and the following is suggested.
>
> Where the acid value is greater than the ester value, that the difference should not exceed 0.3 cc. N/5 soda [we suppose caustic soda] per gram and the bromine figure should not exceed the acid value by more than 0.15 cc. in similar terms. Where the ester exceeds the acid, the excess should not be more than 0.3 cc. soda per gram and in this case the bromine figure should not exceed the ester value.
>
> For free salicylic acid the limit should not be more than 0.15 per cent.

We cannot concur in this. Our experience shows that very few of the samples examined would come within these requirements. In our opinion the quality of the aspirin depends much upon the technic employed in its preparation. A well-washed sample is free from sulphate and chlorine ions. If it has been crystallized from a solvent other than water, and has then been thoroughly dried, its melting point will approach that of the pharmacopœias, and the liability to hydrolysis will have been minimized.

Nevertheless, all the requirements of purity which are valid in other countries should be modified after the drug has been subjected to our climatic conditions. All changes should be studied in situ, and the constants determined and required in other countries should not be indiscriminately applied here. In our opinion, if the United States Pharmacopœia is official in the Philippines, we should have an extra Pharmacopœia, something like the "Indian and Colonial addendum" that British India has for the British Pharmacopœia, wherein we might include not only our best-known indigenous remedies, but also the tolerable variations in the constants of imported drugs due to our climatic conditions.

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[9] Chemist and Druggist 91 (1919) 473.

[10] Op. cit. 61.

GEOLOGIC RECONNAISSANCE OF THE PIDATAN OIL FIELD, COTABATO PROVINCE, MINDANAO

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TWO PLATES AND THREE TEXT FIGURES

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INTRODUCTION

During the latter part of February and the early part of March, 1921, the writer was engaged in a geologic reconnaissance in the vicinity of the Pidatan oil seep in the northern part of Cotabato Province, Mindanao, just south of the boundary between Lanao and Cotabato. He was detailed by the Governor-General to accompany the party of Mr. M. L. Benedum, a prominent oil operator of Pittsburgh, Pennsylvania. Mr. W. C. Spooner, chief geologist for the firm of Benedum and Treves, was also a member of the party, and the following report is a summary of the findings of the work done jointly by Mr. Spooner and the writer. However, the writer alone is responsible for the statements contained in this article.

On March 9 the Bureau of Science issued a press bulletin (No. 99) which was prepared by the writer, giving the general results of this expedition. As all details had to be eliminated from the bulletin it has been thought advisable to publish further, more-detailed information about this region for the benefit of those who may wish to examine it in the future. It should be borne in mind that this is a very inaccessible region and very difficult to traverse, and that the time spent on the ground was just a week.

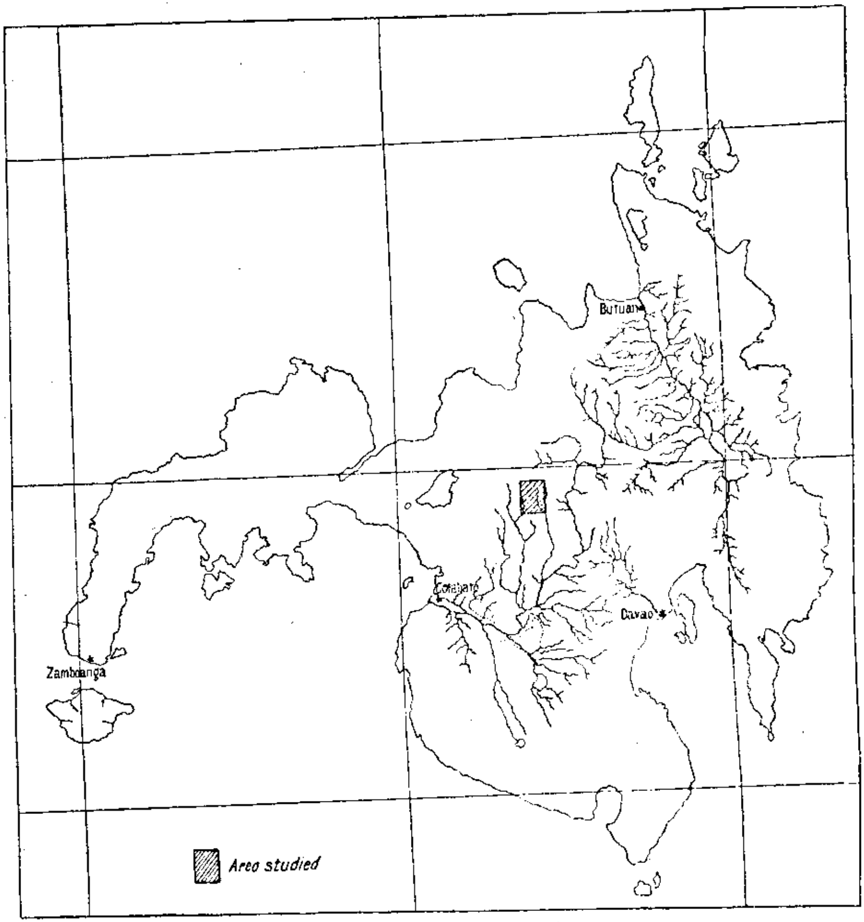

FIG. 1. Mindanao, showing the location of Pidatan oil seep.

GENERAL RESULTS

In the first place it should be stated that the results have been in the main negative; that is to say, the geological reconnaissance in the vicinity of the oil seep has revealed very unfavorable features, and the writer does not hesitate to condemn this locality as a prospective oil field. He is led to this conclusion by a consideration of the unfavorable geologic conditions as well as the difficulties of transportation, labor, supplies, etc. In view of all these facts it is thought that any large expenditure of money or time in this locality would not be justified. There is undoubtedly oil in this field, but drilling here is not considered an economic undertaking.

On the other hand, the consensus of the geologists and the practical oil men of the party is that further intensive exploration in near-by regions of central Mindanao, either by the Government or by private capital, would be desirable. However, from the nature of the country and of the geological conditions, this work will require the services of many men for many months, at heavy expense. In order to get the geological facts about this region, it is necessary to use bolo-men constantly, and even with this aid the solving of the geological problems is very difficult and uncertain, owing to the scarcity of outcrops just where they are needed to complete the story. Without geological study practical oil men will not consider further expenditure. As the division of mines of the Bureau of Science is at present pitifully undermanned, there being one field geologist now (July, 1921) in the Government service, this work cannot be even considered by the Bureau of Science.

GEOGRAPHIC

Location.—The field investigated (fig. 1) is situated about 60 kilometers due north of Fort Pikit, Cotabato Province, Mindanao, which in turn is situated some 70 kilometers up the Rio Grande de Cotabato and therefore is very nearly in the heart of the great southern island. To the north of the field lies the volcanic range containing the active volcano of Mount Ragang, which in turn lies just back of Lake Lanao. To the west runs the line of hills and mountains known as the Babuy Mountains. To the east there are some moderately high hills and mountains of limestone, of which Mount Kitubud is the outstanding feature (Plate 1, fig. 2). The principal stream running through the field is the Malitabug which flows almost due south. This is a swift and almost unfordable tributary of the Rio Grande. The wild and picturesque gorge and the natural bridge of the Malitabug are special scenic features of the region. The old Government trail, now almost overgrown, which follows this stream is one of the finest in the Philippines, from a scenic point of view, and the natural bridge crossing the Malitabug is the most remarkable known in the Philippines.[*]

Topography.—In general, the region under consideration may be called mountainous (Plate 1, fig. 1). The western part of the field in the neighborhood of the Babuy Mountains is exceedingly rugged, with elevations up to 1,000 meters. The eastern part of the field is not so high, but owing to the limestone formation generally occurring in that portion the ground is exceedingly rough, and deep gorges are the rule. The center of the field is moderately level and open grassland in the vicinity of Malitabug River. Along Malitabug River are some very conspicuous terraces; three of these are prominently developed and two others are not so well defined. In the southern part of the field, just north of Fort Pikit, there is a great number of low hills, in part wooded and in part grass covered. Some of these hills are rounded and are made up of shales and sandstones, but many others are composed entirely of coral limestone and are generally flat topped. The hill on which Fort Pikit is located is typical of many of these hills (Plate 2, fig. 2). This is a raised coral reef of late Pleistocene or early Recent time. These outliers on the average stand about 50 meters above the Rio Grande. To the east of them lies the vast flat-bottomed valley of the Rio Grande.

After one has made a short study of this region, it is fairly easy to determine from a distance the general type of rocks underlying the different kinds of topography. For example, shale and sandstone are usually indicated by rolling, grass-covered hills; igneous rocks are found in the high, rugged, partially wooded mountains; the limestone areas are intermediate in elevation, usually with steep slopes and escarpments, and generally densely wooded. Traveling in the limestone areas is most difficult, owing to the considerable amount of solution-yielding caverns and sinks.

There is no accurate topographic map of this region available. An approximation to the topography indicated by hachures is found in the map issued by the Philippine Constabulary. The writer has seen a contour map of a portion of Cotabato Province, made some years ago by the topographers of the United States Army, but this map is not for general use. It is also known that private companies recently making investigations in this field have made topographic maps of a portion of this country; these also are not available to the public. The best way to map this country would be by photography from aëroplanes or by triangulation and plane-table sketching. The use of transit and steel tape is not necessary, as the preliminary geological work in this region does not call for such accuracy nor for any great detail. This is a mistake that some geologists and engineers from the United States are prone to make.

Transportation.—Transportation to the Pidatan oil seep is first by launch from Cotabato to Fort Pikit, distant about 70 to 80 kilometers; thence by horses and cargadores over the Government trail, distant about 60 kilometers. The last 1.5 kilometers are exceedingly rough, and dangerous for horses, and should be made on foot. The trail (and this is practically the only trail worthy of the name in the region) as far as the forks, about 2 kilometers south of Banisilan, is a fairly good one. From this point to the seep the trail ascends gradually to an elevation of between 750 and 900 meters, and is exceedingly rough in places. The other branch of the trail continues to Banisilan, and is very good. The ford across Malitabug River below Banisilan is at times difficult to make, and during the rainy season practically impossible.

The country is very sparsely inhabited, hence the absence of good trails; such trails as exist are almost concealed and overgrown by the high grass (cogon and tigbao) which runs riot. With the exception of Banisilan, where there are a Constabulary outpost and a Moro farm school, there is no settlement worthy of the name. However, at Bao, one day's ride north of Pikit, there is a fairly good Government rest house with a telephone to Pikit and Cotabato. A few Moros and Manobos live in scattered groups of houses throughout this region. One sees scarcely more than a half dozen families in one settlement. The country is exceedingly wild and difficult, but gives one the impression of being capable of great development, particularly along agricultural lines. There is one small herd of cattle in the region which belongs to a Government company. For all supplies, transportation, etc., persons going into this region are dependent upon the Constabulary and upon Mr. Manion, the superintendent of the Moro Farm School at Banisilan. All arrangements of this kind should be made through the commanding officer at Cotabato. The present commandant is Captain Gutierrez, an exceptionally obliging and efficient officer; Captain Feria, at Fort Pikit, is an able second to Captain Gutierrez. Accommodations for small parties are available at Fort Pikit. Of course, any visitors to this country will naturally wish to visit Datu Piang, at Dulauan. Datu Piang is the most influential Moro in the province. Deputy Governor Abad, of Cotabato, who lives at the Agricultural Colony, just below

Pikit, is both very able and willing to assist visitors to this region.

Valuable notes relating to costs of transportation and supplies, furnished by Captain Gutierrez, of the Philippine Constabulary, are printed in the appendix to this article.

Climate.—Cotabato Province is in that portion of the Archipelago having no sharply defined rainy and dry seasons. January and February are generally considered the best months for field work. This region is outside the typhoon area and, therefore, is scarcely ever subject to storms. As there is no meteorological station nearer than Cotabato, near the coast, the writer does not know the rainfall of this interior basin. At Cotabato the mean annual precipitation is given by the Philippine Weather Bureau as 2,272 millimeters. It is probable that it is somewhat below this figure in the central Cotabato Valley.

At Cotabato the mean annual minimum temperature is 19.7° C., the mean annual normal is 26.6° C., and the mean annual maximum is 33.8° C. The annual normal is slightly less than that of Manila.

Population.—The population of Cotabato Province is about 21,000 persons, consisting largely of Moros segregated in towns along the Rio Grande, with some Manobos scattered through the hill country. In the Pidatan district the population is very sparse.

The Moros are Mohammedans, while the Manobos are pagans. Judged by the standards prevailing in the Christian provinces, these people are extremely backward. They engage in very crude agriculture, fishing, and trading. In the Pidatan district the few Moros and Manobos present lead an exceedingly precarious existence and appear to be on the verge of extinction.

GEOLOGIC

General statement.—The geology of the region briefly stated is as follows: The principal formations, as indicated on an early map published by the division of mines of the Bureau of Science, consists of Tertiary sediments: limestones, sandstones, and shales. These are intruded on the edges of the field by igneous rocks, principally basalts and andesites. There is considerable agglomerate also in the region. Owing to these intrusions and also to more widespread regional earth movements, these sediments have been folded and faulted, as in other parts of the Archipelago; some of them, especially the lower series, including the Vigo shales (the petroliferous horizon of the Philippines), very profoundly. In the region adjacent to the seep the formations which might be counted upon to contain oil are so badly disturbed that no regular structures could be made out, and as this is the crux of the whole matter in an oil field, a favorable impression of this locality cannot be entertained. This does not mean that oil does not exist there. It might even be there in fair quantity; but with other difficulties, already referred to and which must be considered, drilling for oil does not promise to be an economic venture. This is a feature which many would-be oil producers do not adequately consider. Both the location of the seep and the composition of the oil, which has none of the light fractions and very little residue either of paraffine or of asphalt, indicate very local and abnormal conditions.

Description of formations.—The tentative stratigraphy of the Pidatan field is shown in Table 1. Beginning at the bottom the oldest rocks seen by the writer are the Vigo shales, with which are intercalated thin-bedded, sandstone layers. No deep-seated igneous rocks were noted, and it is probable that erosion has not proceeded far enough to reach them. The Vigo shales in this region are very much like the same formation in other parts of the Philippines, particularly in Bondoc Peninsula. A typical specimen is buff-colored with dark variations, exceedingly fine-grained, but not showing many microscopic forms such as *Globigerina,* as in the case of the Bondoc or Leyte shales. The shales and sandstones in this series are thin-bedded, and the shales break with a conchoidal fracture. Very few fossils were found in them. Structurally this formation is badly disturbed. Dips of 15° to 45° are common, and several outcrops show the shales and sandstones standing on end; that is, dipping 90°.

Overlying the Vigo series and with a marked angular unconformity is the Malumbang formation consisting of three members, as follows: The uppermost is limestone, fairly hard and white, and contains fragments of coral; below this is a soft, marly facies, quite fossiliferous; the principal genera found in this marl are *Cardium, Arca,* and *Tellina.* Below this marl comes a coarse, yellowish sandstone which contains a few fossils including some fragments of reef corals, and from the presence of these reef corals the writer concludes that this sandstone belongs with the Malumbang rather than with the Canguinsa, which was not seen by him and may be missing. Detailed work here may cause him to change this opinion.

Above the Malumbang come two or three formations, the exact positions of which are somewhat uncertain, particularly that of

TABLE 1.—*Provisional stratigraphy of the Pidatan oil field, Cotabato Province, Mindanao.*

Period.	Formation.	Lithology.	Estimated thickness.	Remarks.
			meters.	
Recent	Malitabug	River terrace deposits	75	Five terraces.
Pleistocene	Pikit	Raised reefs	50	Species of modern reef corals.
Lower Pleistocene or Upper Pliocene.	Banisilan	Coarse sandstone and shales	200+	Fresh-water and estuarine deposits; contain fragments of cogon leaves and stems of reeds.
Unconformity				
Pliocene	Malumbang	Upper coral limestone	300+	Fossil corals, very similar to those above mentioned.
		Marl		Contains numerous casts of pelecypods.
		Sandstone		Contains isolated fragments of reef corals.
Unconformity				
	Babuy	Andesitic agglomerate and intrusions	(?)	A part of the andesite and basalt intrusions of this region.
Miocene	Vigo	Shales and sandstones	(?)	Badly disturbed in region of seep.

the one which we shall call the Banisilan formation. This consists of coarse sandstones and interbedded shales, which the writer considers to be in part of fresh-water origin, since they contain fragments of wood and impressions of grass and reeds. This formation lies nearly flat in the vicinity of Banisilan, with a slight dip, not over 2°, however, to the southwest. In Malitabug River (Plate 2, fig. 1) a few kilometers south of Banisilan, are almost flat-lying loose shales belonging to this formation, but differing in lithology from those of the type locality near Banisilan.

From collections made in other localities by Mr. Moody and determined by Dr. R. E. Dickerson it seems that this formation was deposited in an embayment of the sea where leaves and grass stems were occasionally washed in. A good fauna was obtained by Mr. Moody from near Matinao about which Doctor Dickerson has kindly furnished the following notes:

The following species were collected from the Banisilan formation by Graham B. Moody at his locality 424 which he described as being 1.6 kilometers east of Matinao, and 0.6 kilometer west of Malitabug River, Cotabato, Mindanao:

List of species from Moody's locality 424.

GASTEROPODA

Calliostoma sp.
Cancellaria oblonga Sowerby.
Capulus sp.
Cerithidea sp.
Conus sp., large.
Conus lividus Hwass.
Conus insculptus Kiener.
Cypraea erosa Linnæus.
Cypraea sp.
Distortio clathrata Lamarck.
Dolium sp.
Eulima sp.
Murex cf. *pliciferas* Sowerby.
Nassa crenulata Bruguiere.
Nassa.
Natica albumen Lamarck.
Natica mamilla Lamarck.
Natica spadicea Reeve.
Pustularia nucleus Linnæus.
Ranella subgranosa Beck.
Ranella sp.
Sigaretus eximius Reeve.
Triton clavator Lamarck.
Turris flavidula Lamarck var. *sonde* K. Martin.
Terebra.

PELECYPODA

Arca cf. *barbata* Linnæus.
Arca cornea Reeve.
Cardita antiquata Linnæus.
Cardita pica Reeve.
Chama sp.
Cardium unicolor Sowerby.
Chione sp.
Corbula sp.
Glycimeris angulatus Lamarck.
Leiconcha trimaculata (Deshayes).
Lima sp.
Lucina sp.
Macoma nobilis Hanley.
Ostrea sp., a.
Ostrea sp., b.
Pecten squamosa Gmelin.
Pecten sp.
Spondylus sp.

COELENTERATA, ETC.

Echinoid spine.
Flabellum cf. *australe* Moseley.
Balanophyllia.
Cycloseris sp.
Three other coralline forms.
Vermes sp.

All the forms specifically identified are Recent species. The two forms *Flabellum* cf. *australe* Moseley and *Balanophyllia* also occur in Moody's locality 314, Agusan Valley, Agusan Province, where they are associated with—

GASTEROPODA

Cassis sp.
Cyclonassa elegans Kiener.
Nassa globosa Quoy.
Nassa crenulata Lamarck.
Nassa canaliculata Lamarck.
Cerithium jonkeri K. Martin.
Turritella terebra Lamarck.
Turris carinata.

PELECYPODA

Arca ferruginea Reeve.
Paphia striata Chemnitz.
Flabellum cf. *australe* Moseley.
Balanophyllia.
Cycloseris sp.

The form *Flabellum* cf. *australe* Moseley is identical with the species listed by Warren D. Smith from near Aroroy, on the west side of Aroroy Bay, Masbate, Bureau of Science locality F907, where it has a similar association as indicated above. The *Balanophyllia* may be an extinct species and the writer regards the association of these forms with similar assemblages of Gastropoda and Pelecypoda as not merely adventitious but indicative of essential synchrony. In other words, the Banisilan formation is equivalent to the beds exposed at Aroroy and the nearly horizontal beds at Moody's locality 314 in Agusan Valley. The latter are probably equivalent to beds referred to the Pliocene by Martin. Martin[1] listed Mindanao fossils as follows:

1. Left bank of Agusan River at Tagasáp.

Latirus madiunensis Mart. P.
Murex microphyllus Lam. M; L.
Ranella raninoides Mart. M.
Ranella gyrina Linn. L.
Turritella terebra Lam. Q; L.

2. Agusan River between Pagasap and Libuton.

Turritella terebra Lam. Q; L.
Venus squamosa Lam. P; L.

3. Maasin on the Agusan.

Conus insculptus Kien. M.; L.
Turricula bataviana Mart. P.
Murex verbeeki Mart. P
Natica mamilla Lam. M; L.

4. Salac y Maputi River.

Murex verbeeki Mart. P.
Strombus isabella Lam. Q; L.
Natica mamilla Lam. M; L.
Arca granosa Linn. P; L.
Clementia papyracea Gral. M; P; L.
Corbula scaphoides Hinds. M; P; L.

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[1] Martin, K., Concerning Tertiary Fossils in the Philippines, English translation, Twenty-first Annual Rep. U. S. Geol. Surv. pt. 3 (1901) 619, 622, 623.

5. Zamboanga, river bank 2.5 miles north of Zamboanga, upper stratum.
Murex capucinus Lam. L.

Concerning these species, he states his opinion on pages 622 and 623:

"As for Mindanao, it can not be demonstrated from specimens which have been investigated that Miocene strata occur there, for I have but a single species, *Ranella raninoides* Mart., which is known only in the Miocene. On the other hand, it is clear that there are upper Tertiary beds along the Agusan River. If it were permissible to assume that all the fossils of the list given above originated in equivalent beds, and their state of preservation makes this probable, there would be in all 10 species, 6 of them, or 60 per cent, still living; 4 species occur in the Miocene and the same number in the Pliocene; but of these last three are known only from the Pliocene. These are *Latirus madiunensis* Mart., *Turricula bataviana* Mart., and *Murex verbeeki* Mart. All this argues the occurrence of the Pliocene on the Agusan River, and in harmony with this indication is the exceedingly fresh appearance of the fossils at hand.

"The same age finally may be ascribed to the fossils from the river Salac y Maputi in Mindanao; for although of the 6 species determined from this locality no fewer than 5 belong to the present fauna, yet of these latter 4 reach back to the Miocene and Pliocene and a single species *Murex verbeeki* Mart., is known only in the Pliocene. Of the deposit at Zamboanga nothing definite can be said as yet on the strength of the solitary fossil *Murex capucinus* Lam.

"To the age determinations of Philippine fossils it is proper to add that their state of preservation resembles that of the Javanese fossils to a very remarkable extent—to such a degree, indeed, that the specimens from the two regions might easily be confounded. The same statement is true of the tuffs and marls in which they were embedded, and this accords with the fact that the younger massive rocks of the Philippines show an extraordinary likeness to those of the East Indian Archipelago."

The writer is in entire agreement with Martin's assignment of the Agusan beds to the Pliocene and their analogues, the Banisilan formation, as well. The descriptions of Moody and Smith of the stratigraphic relations of the tuffaceous sandstones at Banisilan yielding the above fauna to the conformably underlying coralline limestone indicate that the Banisilan is upper Pliocene since the coralline limestone is largely composed of corals characteristic of the Malumbang formation of Pliocene age.

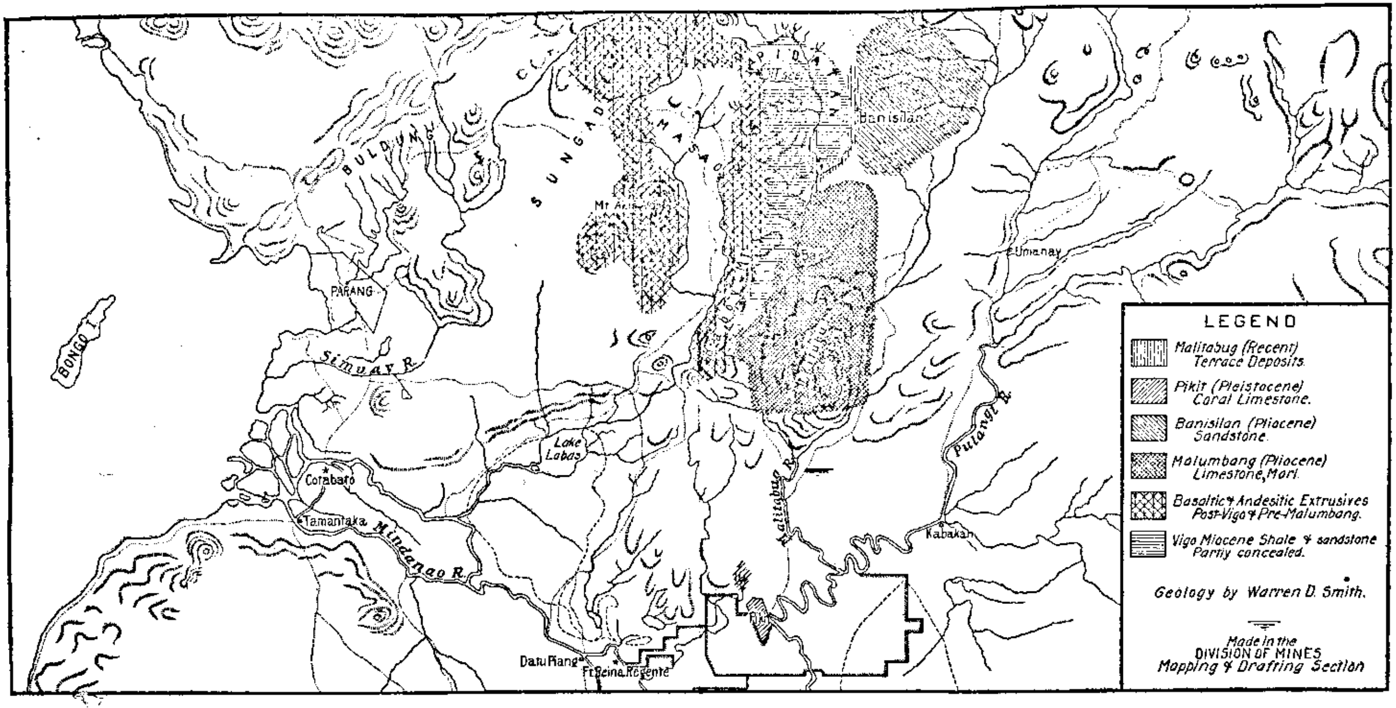
Percentages given in Martin's statement above are calculated on a total of ten species from four different localities and the number of forms is too small to be truly significant. The *Turricula bataviana* Martin occurs at Bureau of Science locality F1054 near San Rafael, Agusan River, where it is associated with a fauna containing at least from 90 to 95 per cent Recent species. Without going into great detail, the writer's judgment concerning the age of this fauna is strongly influenced by a recent study made upon a fauna obtained from the Vigo group of Miocene age which contained an astonishingly large number of Recent forms. The conclusions given in this paper are that the evolution of Gastropoda and Pelecypoda in the Tropics is far slower than in the Temperate zones and hence a different percentage scale in the Tertiary must be applied in evaluating the Miocene, Pliocene, and Pleistocene of the Torrid zone.

Above this formation stratigraphically, but not always topographically, are two formations which are probably contemporaneous. One, which comprises the terrace materials along Malitabug River, the writer called the Malitabug formation; to the other, comprising the elevated coral reefs so well developed in that locality, he gives the name of Pikit, These two, he considers, date from the late Pleistocene. The Banisilan formation he assigns to the early Pleistocene or late Pliocene.

In this region are several types of igneous formations. The Babuy Mountains are a great mass of andesite and basalt, and on the flanks of these mountains there is considerable andesitic agglomerate. These materials, the writer believes, are intrusive in the Vigo formation, but not in the Malumbang; that is, they are post-Vigo and pre-Malumbang. At the seep on the flanks of the Babuy Mountains the oil appears to be issuing along a fault plane on one side of a dike which runs out from the main mass in an east–west direction. The rock is so badly weathered and decomposed (it is also somewhat metamorphosed) that it has been difficult to make an accurate petrographic description of it. There seems to be no question that it is igneous. On the hanging wall there is a very much-broken mass of material which may be either agglomerate, locally brecciated igneous rock, or merely talus. Thin sections of this igneous rock showed considerable decomposition and crushing, giving to the section the appearance of a volcanic tuff. There are some large crystal fragments in the section, principally of feldspar. There is a suggestion of clastic texture, but the writer is of the opinion that this is secondary. Therefore, it is difficult to state positively just what this material is. It appears, however, to be a badly crushed andesite or basalt. In an unpublished report on this region the opinion is expressed that this seep is located along a fault plane in sandstone. Neither the field nor the laboratory examination of this rock, in the opinion of the writer, justifies this classification.

Owing to the lack of detailed work in the region, we can give only an approximation to the thickness of the various formations in this region, and such estimates as we can make are shown in Table 1.

The general distribution of some of these formations is shown on the sketch map, fig. 2. From the nature of the topography


BULDUNG
SUNGAD
PIDATAN
MASAO
Banisilan
Mt Aris
Umanay
PARANG
BONGO I.
Simuay R.
Lake Labas
Cotabato
Tamantaka
Mindanao R.
Malitabug R.
Pulangi R.
Kabakan
Pikit
Datu Piang
Ft. Reina Regente
LEGEND
Malitabug (Recent) Terrace Deposits.
Pikit (Pleistocene) Coral Limestone.
Banisilan (Pliocene) Sandstone.
Malumbang (Pliocene) Limestone, Marl.
Basaltic & Andesitic Extrusives Post-Vigo & Pre-Malumbang.
Vigo Miocene Shale & sandstone Partly concealed.
Geology by Warren D. Smith.
Made in the DIVISION OF MINES Mapping & Drafting Section

Base taken from large map by the Philippine Constabulary.

FIG. 2. Sketch map, showing areal distribution of formations in the Pidatan district, Cotabato, Mindanao.

and their areal distribution it appears probable that Malitabug River is located along a fault line. In fig. 3 is shown a generalized cross-section suggesting the geological relationships in this region.

ECONOMIC

Description of seep.—The only indication of petroleum in this field is a single seep, and a very small one at that, which is located in a ravine on the headwaters of Kirusoy Creek, a tributary of Malitabug River. This is well up the side of a partially wooded range of igneous rock, and on the south side of what appears to be an east–west dike running from the main mass.

The amount of oil and gas issuing at this point is very small; compared with other seeps in the Philippines and elsewhere, it is not very encouraging. It is said that a 5-gallon can of this oil can be collected in a day from this seep. The writer doubts this. In Table 2 is presented the analysis of this oil made by chemists of the Bureau of Science and, in Table 3, another analysis, by Mr. Winkler, chemist for the United States Army Quartermaster, Manila. Accompanying the analysis by Mr. Winkler, is a memorandum relative to the possible uses for this oil. It will be noticed that this oil has neither "head" nor "tail;" that is to say, the light fractions such as gasoline, benzene, and kerosene are absent, and it has only from 1 to 2 per cent of wax, or paraffin, residuum. This indicates that the oil is abnormal and has lost some of its constituents in migration. Therefore, it is presumed that either the oil has come from a considerable distance through the formations or it has suffered distillation locally, due either to the heat of cooling igneous rocks or to heat generated during metamorphism. In the parlance of the practical oil man this is a "wild" oil.

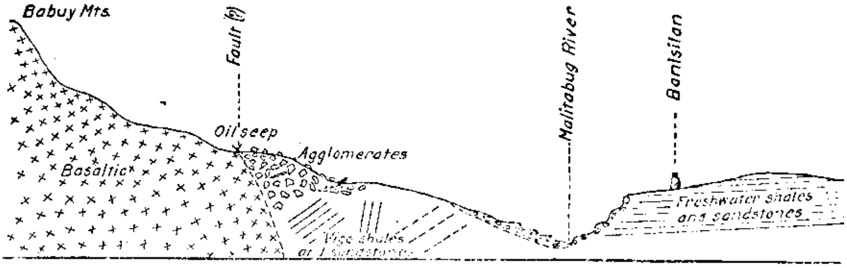


FIG. 3. Generalized cross-section east and west through Pidatan oil seep.

TABLE 2.—*Analysis of oil from Pidatan, Mindanao.*

[Analysis by the Bureau of Science.]

Specific gravity at 15.6° C.	0.9297
Distillation:	
Light oils (below 150° C.)	None.
Burning oils (150° to 300° C.)	45 per cent by volume.
Heavy oils (300° to 400° C.)	49.5 per cent by volume.
Residue	5.5 per cent.
Sediment	Large amount.
Water	Trace.
Base	Paraffin.
Main calories or gross heating value	12,495.
Available heating value	11,189.
Sulphur	1.56 per cent.

TABLE 3.—*Cotabato oil, from Mindanao, P. I.*

[Analysis by J. Winkler, chemist, Quartermaster Corps, United States Army.]

Gravity at 60° F.	20.5 Bé.
Specific gravity	0.928
Flash, open cup	233° F.
Moisture	Traces only.
Sediment	Traces only.
Fire, open cup	261° F.
Asphalt	0.00
Wax, approximate	1–2 per cent.
Gasoline	0.00
Benzine	0.00
Kerosene	0.00
Sulphur	Trace only.
Saponifiable, as resin oils	0.00
British thermal units	19.965 [a]

[a] Determined by the Bureau of Science.

Direct industrial uses:

(*a*) This oil as it stands is splendid Diesel engine fuel, and it is splendid oil for compressed air burners for furnaces. Or, it is splendid for mixing with the "to heavy" California crude petroleums for both purposes named above.

(*b*) It is an excellent oil for oil-burning ranges in hotels et al. where "soot less" odorless flame is required.

(*c*) It can be used as lubricant with constant "drip" . . . on bearing.

(*d*) Because so low in sulphur, it would be an excellent solvent in the rubber recovery.

Manufactured products from this oil:

(*a*) By simply blowing hot air through this oil, it becomes splendid transformer oil since so low in sulphur. Also a light household lubricant, as is "3 in 1" oil, etc.

(*b*) By steam distillation: Three products can be made; viz.:

(1) Heavy illuminating oil for bunker lamps, an oil of greater safety than kerosene. Also a cleaning oil. A floor oil.

(2) Lubricating oil for light machinery . . . some 40 per cent by volume.

(3) Heavier lubricating oil, by distilling off the light portion, and refining the residuum with sulphuric acid, washing with water, some 20 per cent by volume.

Samples of these products were made in the laboratory with amounts obtainable indicated, and these submitted with this report.

Exploitation.—Diligent search within a radius of several miles of the seep for favorable oil structures was made, but none was found. It is true, one little anticline, only a few meters in width, was seen in a section along the banks of Malitabug River, but this indicates merely a local roll and nothing of economic importance. In fact, the Vigo formation is so badly disturbed for some kilometers from this seep that it is extremely doubtful that a suitable structure could be found. The writer is informed that the present drilling sites in Borneo are about 50 kilometers from the discovery seeps. In general, it would be good policy to go some distance from this locality in a search for favorable structures. The writer does not hesitate to condemn all the country within a radius of 10 kilometers of this seep. However, he is of the opinion that further intensive geological exploration in the country to the east and south of this oil seep not only would be justified but would probably yield results. This subject is discussed further in a later paragraph.

It is not sufficient merely to find oil in the rocks; there must be oil in sufficient quantities and in an accessible location so that it can be marketed economically. As this is just where many oil-development projects fail the writer takes particular pains at this time to indicate some of the factors involved in the development of a region like this one.

In the first place, there must be the preliminary geological exploration, conducted in much greater detail than was the survey upon which this article is based. This will require the services of two or more geologists and assistants working steadily for at least six months, and possibly a year. This is the minimum, and it would be well to expect to spend at least 15,000 pesos in making such a survey.

Next will come the building of a road, in order to get machinery to the drill site. The writer has heard of estimates of 25,000 dollars (50,000 pesos) for the total cost of a road into this locality. Such estimates are absurd. It will cost in the neighborhood of a half million pesos, and very probably much more, to build a suitable road in this locality.

The drilling of one well to a depth of 1,000 meters, including the cost of machinery set up on the ground, will cost about 200,000 pesos.

A pipe line out of this field would require at least 2,000,000 pesos, and then a refinery, with tanks and with transportation facilities, will call for another 5,000,000 pesos, at the lowest. It can be easily seen that the expenditures for any real operations in this country will mount rapidly to the 10,000,000-peso figure.

Labor.—Practically all labor for operations on a large scale in this country will have to be brought in from the outside. The Moros and Manobos cannot, in the writer's opinion, be counted upon either in numbers or in quality of work. The bulk of the labor will have to come largely from the Visayan Islands or from still farther north. The average wage for common labor in this country is from 80 centavos to 1 peso per day. All skilled labor and equipment will have to be brought from the United States, and all supplies from Manila. In landing machinery and supplies in this field there will be heavy freight, insurance, and lighterage charges.

Hints to explorers.—Elsewhere [2] the writer will publish some instructions to exploring parties who intend to visit this region. Therefore for editorial reasons they are not incorporated in this article. A general word of advice is inserted here; namely, before leaving the United States or other foreign country such persons should write either to the Bureau of Insular Affairs in Washington, or direct to the Philippine Bureau of Science in Manila for full directions. Unless one has had previous experience in the Islands he should not for a moment presume to guess about these matters, because guesswork would result in inconveniences and might prove to be fatal.

For the guidance of persons going into this region a few figures relating to costs and transportation, furnished by Captain Gutierrez, senior inspector of Constabulary of Cotabato Province, are given in the appendix.

Geological exploration.—As preliminary work in this region, the writer would suggest that a detailed section be made of Malitabug River to the Lanao boundary, another from Malitabug River due east through Banisilan to Pulangui (Rio Grande or Cotabato) River, and a third from Malitabug River due west to Parang. After this work, which will require at least three months, has been completed the work to follow will naturally suggest itself. A general reconnaissance should be made first; detailed mapping should not be attempted in the beginning. It is not necessary to go to the elaborate precautions of keeping extra barometers in camp in order to check the one used in the field; the dip or strike of an outcrop recorded with an accuracy of a degree will be close enough. Some geologists doing reconnaissance work in the Philippines make the mistake of attempting too much detail, and they waste time in trying to be precise. It is not necessary in route surveying to set up the instrument over a tack when an error of several feet could not be shown on the scale of the map.

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[2] Manual for Scientific Travellers, Delft. (In preparation.)

CONCLUSION

While the geological conditions in the vicinity of the Pidatan oil seep are unfavorable and not much encouragement can be given for development in that particular locality, the writer is of the opinion that in near-by regions of central Mindanao, in the areas covered by sedimentary rocks, there is the possibility of locating oil structures; this can be determined by future geological exploration. At this point the writer would caution those who are not initiated into the intricacies of the oil business that such geological exploration is absolutely essential. The large, successful concerns in the oil business to-day would not think of proceeding without such work. Yet, once in a while, one hears the man in the street say that he does not care for that sort of thing and that he wants a "practical" man. The writer is as appreciative as anyone else of the practical man in his field, but the work of the geologist is just as practical as that of the driller. It is simply a different kind of work, for which a very different sort of training is necessary, and because the layman does not understand the nature of the work he has no justification for calling it impractical. Often the so-called "practical" man is the most impractical. Men who are well versed in this business know that both the geologist and the experienced driller are necessary to get the oil. Both are apt to make mistakes, but when they work together they reduce the chances for error.

APPENDIX

Launches.—The Provincial Government launch *Ripley*, at 6 pesos per hour, can reach Gocotan on the Maridagao, a tributary of the Rio Grande (Cotabato now), and also Kabacan at the junction of Cotabato and Kabacan Rivers, which are both above

Pikit. From Cotabato this launch takes from thirteen to fourteen hours to reach Pikit; from fifteen to sixteen hours to reach Gocotan; and from nineteen to twenty hours to reach Kabacan. The engineer's launch *Raja*, at 5 pesos per hour, can reach the same points as the *Ripley*, but it is a slower boat. These two launches are always available when not actually in use by provincial authorities.

In addition, the Constabulary, Bureau of Lands, Bureau of Education, and Bureau of Health launches can be made available at an average cost of from 5 to 6 pesos an hour, if officially requested. The Constabulary launch's limit of navigation is Fort Pikit.

The launch *J. H. Hall*, run also by the province, is a good-sized stern-wheel river boat, which ordinarily carries between 100 and 200 tons of cargo. It easily reaches Pikit from Cotabato, but Gocotan and Kabacan with difficulty and at certain times of the year only. The charge per hour for hire of this launch is 10 pesos. It ordinarily takes about twenty-four hours to reach Pikit from Cotabato, after a few hours' stop at different points.

Vintas.—Vintas are obtainable from most points along the river where there are Moro settlements, through Government authorities or Moro datus. If time is given in advance twenty or more vintas can be obtained. The hire of small vintas alone is from 50 centavos to 1 peso per day, but for the larger size from 1 to 2 pesos. Each vinta should have at least three or four men to run it, for each of whom subsistence at from 70 centavos to 1 peso per day must be paid. The charge for subsistence differs with the locality and the circumstances. Vintas can reach a point near Malitabug camp on Malitabug River with no little difficulty, and can easily reach Kabacan, Gocotan, Pikit, and Dulawan. The vintas travel from 1 to 2 miles an hour against the current when it is not too strong.

Horses.—Ponies are obtainable at Cotabato, Dulawan, Pagalungan, Pikit, and Kidapawan; from 4 to 10 ponies can be hired in each place, if sufficient time is given in advance. It is advisable to get them through the Government authorities or datus. The hire of each horse is 1 peso per day, from the time the horse or pony leaves the owner until it is returned to him. Saddles and bridles should be furnished by the person hiring the horses, as the Moros use either none or poor equipment of this nature.

Cargadores.—Cargadores are obtained principally at Cotabato, Dulawan, Pikit, and Pagalungan at from 70 centavos to

1 peso each per day, depending on the exigencies and the need of their services, in addition to subsistence. Sufficient time in advance should be given to the officials or datus whose aid and favor are asked.

Supplies for cargadores.—Two and a half to 3 chupas of rice per day for each cargador is the rule in this country. There are 8 chupas of rice to 1 ganta. One ganta equals 3 liters, dry measure. A chupa of rice costs from 7 to 10 centavos. Cargadores also subsist on dried fish, salmon, and sometimes chickens and salt. All of these can usually be obtained at Cotabato. Chickens can be obtained in the Moro settlements throughout the country. Dried salted fish at present (May, 1921) costs 90 centavos per kilogram; a case of 48 cans of salmon, 13.44 pesos; salt, 1.70 per sack; chickens, 30 to 50 centavos. The average cost of subsistence per day per cargador is from 30 to 40 centavos.

Supplies for Americans.—American subsistence will cost from 3 to 4 pesos on the average. Cream crackers, rice, and some canned supplies can be obtained at times at Pikit, but stores and market there cannot be depended upon. Chickens and eggs can be obtained at Dulawan and Pikit, if sufficient time in advance is given for procuring them. Chickens cost 30 to 50 centavos each and eggs from 2 to 4 centavos each, depending on the time. Supplies, other than chickens and eggs, which might be obtained at Pikit will cost at least 5 to 10 per cent higher than if purchased in Zamboanga or Cotabato. Canned goods and potatoes should be brought from Manila, Zamboanga, or Cotabato. Supplies are scarce after leaving Cotabato.

Additional information.—The present cost of transporting supplies from Manila to Cotabato is 16.75 pesos per ton. The information given above holds good principally along Cotabato River. The supplies and cargadores are hard to get in these regions. People going into such regions should have a sufficient number of cargadores and extra rations. Travelers should carry plenty of change for paying cargadores when discharged; discharged cargadores should be given sufficient food to last them till their arrival at their homes. People carrying large sums of money should be very careful not to allow outsiders to know it. It is advisable in all cases for travelers to see the Constabulary station commander at Pikit before leaving that point for the interior to ascertain whether it is necessary to have an escort.

ILLUSTRATIONS

PLATE 1

FIG. 1. Topography in vicinity of Pidatan oil seep.
2. Mount Kitubud (Pliocene limestone) and valley of the Malitabug.

PLATE 2

FIG. 1. Pliocene shales on Malitabug River.
2. Fort Pikit on Pleistocene coral outlier in Cotabato Plain.

TEXT FIGURES

FIG. 1. Outline map of Mindanao, showing the location of Pidatan oil seep.
2. Sketch map of the Pidatan district and areal distribution of formations.
3. Generalized cross-section of geology.

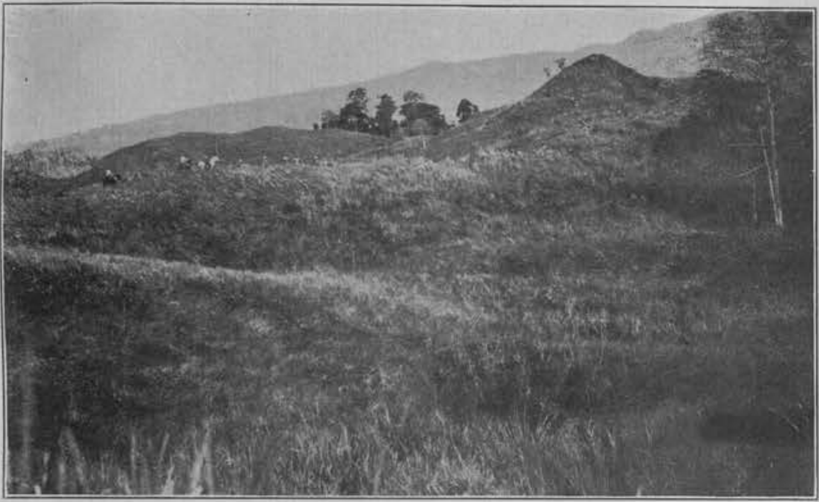

Fig. 1. Topography in the vicinity of Pidatan oil seep.

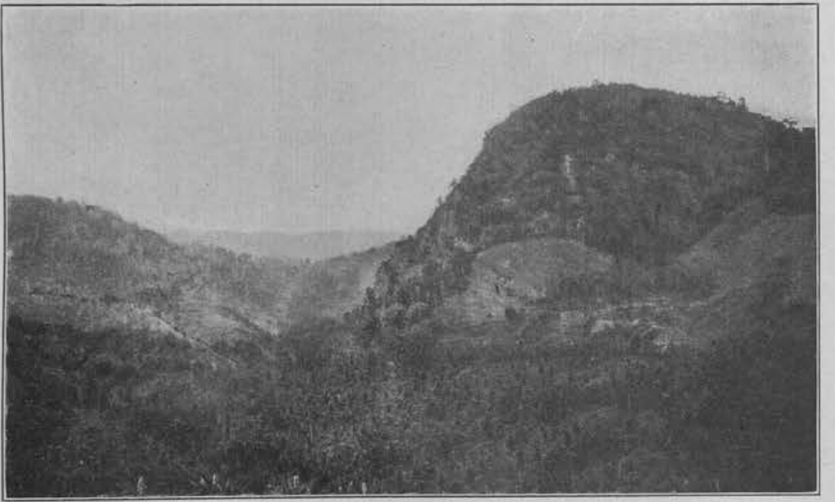

Fig. 2. Mount Kitubud (Pliocene limestone) and valley of the Malitabug.

PLATE 1.

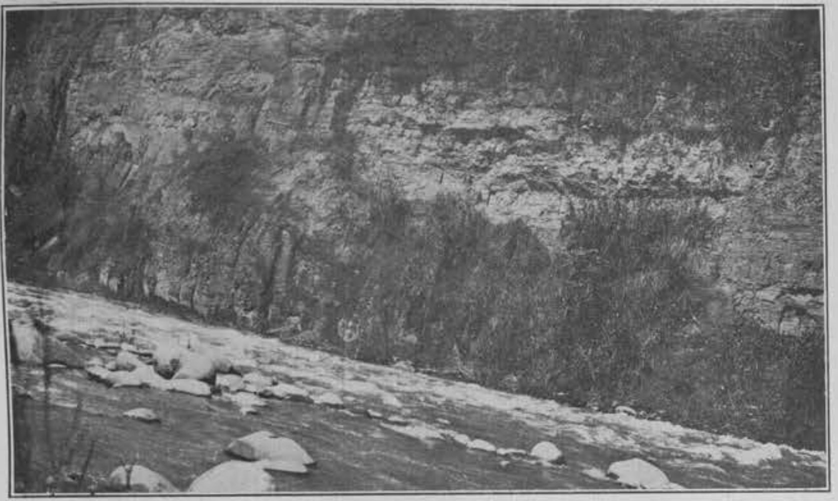

Fig. 1. Pliocene shales on Malitabug River.

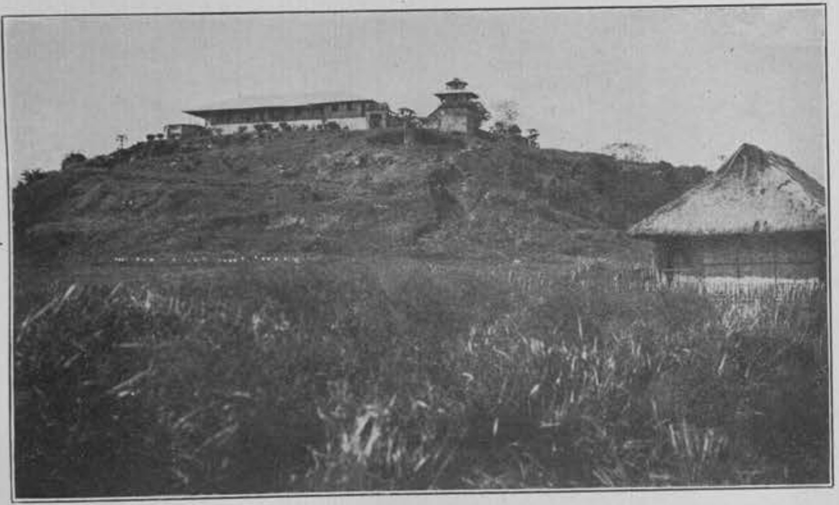

Fig. 2. Fort Pikit on Pleistocene coral outlier in Cotabato Plain.

PLATE 2.

RECENT IMPROVEMENTS IN NIPA-SUGAR MANUFACTURE

By A. H. Wells
Chief, Division of Organic Chemistry

and

G. A. Perkins
Chemist, Bureau of Science, Manila

THREE PLATES

Interest in the problem of palm-sugar manufacture naturally changes from year to year according to the variation in the price of sugar. At present writing the dull market effectually removes any possibility of large investments in the nipa-sugar industry. Nevertheless, in certain portions of the Islands, where nipa is abundant, and pesos to buy cane sugar are scarce, nipa sap continues to be used to a limited extent for the production of sirup for local consumption, and the possibility of manufacturing crystallized sugar remains an interesting one.

Since the work of Gibbs,[1] Pratt, and others,[2] no extensive nipa-sugar experiments have been undertaken by the Bureau of Science, and the present paper, therefore, makes no claim to be complete, but is merely a compilation of observations which the writers have made from time to time during the past two years.

THE NIPA PALM

Although nipa is usually described as having a branching rootstalk or rhizome, the consequences of this fact are not always realized. Perhaps it is more accurate to say that the consequences are not exactly known at the present time. Gibbs seems to assume that the nipa has a definite life period,[3] but the writers have not been able to find any evidence of a natural decline or death of the plant. The decay that can be observed can hardly be called the death of the plant, but is rather a continuous process of decay at one end of the underground trunk, which occurs while the other end is vigorously growing and dividing.

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[1] Gibbs, H. D., Philip. Journ. Sci. § A 6 (1911) 99–206.

[2] Pratt, D. S., and others, Philip. Journ. Sci. § A 8 (1913) 377–398.

[3] Philip. Journ. Sci. § A 6 (1911) 116, 117.

The division of the underground trunk is symmetrical and regular. Very soon after germination the underground stem begins to branch, which is shown by the fact that the leaves develop from two buds, or growing points. These buds grow farther and farther apart as leaf stalks accumulate between them, and each divides again after about two years. (See Plate 1, fig. 2.) When the four- or five-year-old tree begins to bear fruit it has four growing points, which are about a meter apart and form a rough square; these later divide into eight. Plate 1, fig. 3, shows a palm of eight buds or, more probably, a part of a palm of many more buds, which is beginning further division. The clump in the foreground and that in the background were originally one plant, though at the time of the picture the connecting underground trunk had probably rotted away. There is no way of telling how far away these palms are from the original place of germination, but they seem to represent not more than one-half of the total growth from one seed.

A nipa palm does not attain to full height until it is about ten years old, but at this age it apparently reaches a stable state of continuous growth and division at one end of the trunk and decay at the other. So far as the writers can ascertain a cultivated nipa grove is never replanted. Whether a very old grove gives less or more tuba than a young one cannot be stated accurately from available data, but the difference if any is not great.

The difference between nipa groves in different regions is marked. The writers' experiments have been confined chiefly to Manila Bay, Capiz, and Catarman, Samar. The Manila Bay swamps are characterized by their generally cultivated condition. The estimate of 30,000 liters of tuba per hectare[4] seems to be higher than is commercially realized on the average, though yields as high or higher are obtainable from small sections which bear well. The tendency of nipa to bear fruit varies a great deal according to the care of the grove (thinning of the nipa and elimination of underbrush) and other influences not so well understood.

The Capiz nipa is characterized by markedly larger leaves than are seen in Manila Bay. The size of fruits and quantity

[4] Pratt, op. cit. 379.

of tuba from each stalk also seem to be greater. The number of fruits per hectare, however, in the Capiz swamps that were visited is much less than that in the Manila Bay swamps. This is probably because the Capiz swamps have not been extensively used for tuba for a number of years and have been allowed to become dense. The quality of the tuba is about the same (15 per cent sugar) in both places. Just why the Capiz swamps have a sturdier growth is not evident.

The relatively small nipa swamps near Catarman are affected by the strong ocean tides, which cut out deep, narrow channels. This is unfavorable to nipa, as much of the swamp is too high for it and is covered with grass and other dry-land plants (Plate 2, fig. 1). The channels themselves are too deep for the nipa, which is forced to grow on steep banks (Plate 2, figs. 2 and 3). In spite of this fact, and of the crowded condition of the swamps, fruits were found to be plentiful, but the tuba was found to be of poor quality (10 to 12 per cent sucrose).

Besides these general differences between swamps, the plants in a given swamp vary considerably in yield and quality of tuba. How much of this is due to environment and how much can be controlled by a proper selection of seed is a question for valuable but rather tedious experimental work.

Another interesting and important point is the preparation of the fruit stalk for tuba flow. Gibbs says:[5] "According to native superstition the stalk must be kicked, in passing, once a week for five weeks, before it is cut or the sap will not flow freely." The experiments of the writers incline them to believe this "superstition." Several unprepared fruits of different ages which were cut left only dry stalks which did not give a drop of tuba in any case.

PRESERVATION OF TUBA

The very rapid disappearance of crystallizable sugar in tuba is undoubtedly due in large part to enzymes or zymogen[6] present in the sap itself. Without the help of microörganisms, however, these enzymes are not very effective. The fresh juice is practically neutral to phenolphthalein, sometimes giving a slight color, which shows that it is not a favorable medium for the action of invertase. Yeast and bacterial life, however, are very vigorous in a nipa swamp and often attack the tuba even before it drops from the stalk. If a strip of red litmus paper is laid against the cut end of a stalk, from which tuba is coming fairly rapidly, it is turned blue. If, however, a portion of the cut end is giving sap only slowly, that portion will turn blue litmus red. In case the flow is very slow the resulting tuba is strongly acid, and a characteristic white gelatinous deposit forms, in which yeast and bacteria develop rapidly.

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[5] Philip. Journ. Sci. § A 6 (1911) 116, but cf. Conrado, A., and Zóbel, E., Estudio de la planta llamada nipa. Imp. de la Concepción, Manila (1906) 12.

[6] Gibbs, op. cit. 124; Pratt, op. cit. 382.

Similar rapid fermentation and gelatinous precipitate may always be observed in the ordinary *tuquil*[7] used for collecting tuba. This may be reduced to a certain extent by using clean tuquils, especially in the first days of flow, during which the tuba evidently does not contain as much enzyme as later. This fact enables the tuba gatherers in certain swamps to make sirup or noncrystalline sugar from the first few days' flow, collected in clean tuquils. It has been found possible at the Catarman Agricultural School to extend the sirup making throughout the time of flow if the tuquils are washed, disinfected with lime, and placed on the palms in the late afternoon. The night tuba, collected in the early morning, is boiled down to sirup, and the day tuba is used for vinegar.

This sirup-making process is practically the same as that used in India to produce 300,000 tons of crystallized palm sugar annually.[8] The composition of the palm sap (from the wild date and the toddy palm) is about the same as that from nipa, but it may be that the enzymes are not so active. The lower temperature of the Indian groves during the collecting season is doubtless an important factor. At any rate, the Indian palm sap gives crystallized, though impure, sugar, while Philippine nipa tuba, treated in the same way, gives only a sirup or caramel.

Fermentation of tuba may be practically obviated by the precautions mentioned, but inversion, that is, conversion of the crystallizable sucrose into an uncrystallizable mixture of fructose and glucose, is not so easily prevented. Unless a preservative is used the boiled-down tuba is at best an edible sirup or noncrystallized caramel.

PRESERVATION WITH TOLUENE

The experiments with toluene described below were not undertaken with any idea of the commercial use of toluene, but rather as a good method for the chemical study of tuba. Since the completion of these experiments, however, toluene has become much cheaper, and its use may perhaps be considered as a commercial possibility. An advantange of its use is that it preserves the palm flavor and prevents darkening of the sap.

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[7] The Pampangan name for the bamboo receptacle which is hung on the palm stalk. Visayan names are *lacob* and *salud;* Spanish, *bonbon.*

[8] Annett, H. E., and others, Memoirs Dept. Agr. in India, Chem. Series 2 (1913) 281–389; 5 (1918) 68–116.

An experiment on the preserving power of toluene was made in a cultivated Pampanga nipa swamp. Three groups of palms, the fruits of which had been cut at different times, were chosen, and bottles containing 7 cubic centimeters each of toluene were placed on ten palms of each group. The polarization of the tuba was tested after collection for one-half hour. In the A group this was done immediately in the swamp, but this was found to be unnecessary, and the others were analysed a few hours after collection. Group A, which had been producing tuba for about seventy-five days before the experiment, showed by direct polarization 10.6, 10.7, 10.8, 11.7, 11.8, 11.8, 12.3, 12.3, 13.1, and 13.3 per cent sucrose. Group C, cut about forty days before the experiment, showed 13.6, 13.6, 13.8, 14.3, 14.6, 14.7, 15.3, 15.4, 15.6, and 16.1 per cent sucrose. Group D, cut eleven days before the experiment, showed 13.2, 13.2, 13.4, 13.9, 14.6, 14.8, 14.9, 15.4, 15.7, and 16.1 per cent sucrose.

The behavior of composite samples from these groups on preservation under a layer of toluene is shown in Table 1. It may be seen that inversion took place slowly. Meanwhile the Brix of the five samples, 14.8, 14.3, 17.2, 17.2, and 17.3, remained constant within the limits of error, and a very slight acidity to phenolpthalein appeared, in no case exceeding 0.02 per cent (as acetic).

TABLE 1.—*Percentage of sucrose in tuba preserved under toluene.*

Group.	Fresh.	Two weeks.	Six weeks.	Remarks.
	Per cent.	*Per cent.*	*Per cent.*	
A	11.9	9.1	5.9	Filtered.
A	12.0	10.0	6.7	Not filtered.
C	14.9	14.2	12.5	Filled to the cork with toluene.
C	14.9	14.1	12.7	Thin layer of toluene.
D	14.6	13.0	10.1	

The quality of the tuba seems rather poor for Pampanga, probably because the work was done in March, which is not the natural tuba season in that province. These palms had been tapped late in order to lengthen the season.

Following a suggestion by Gibbs,[9] that the development of the tuba invertase from a zymogen may require air, various experiments were tried with inert oils, such as kerosene, instead of toluene. Since these were found to have little inhibitory effect on the fermentation, it seems that the main action of toluene is as an antiseptic, and that inversion of tuba takes place only very slowly unless assisted by yeast or bacteria.

LARGE-SCALE COLLECTION OF TUBA

Due to the high price of toluene at the time of experimentation little beyond laboratory-scale work has been done with toluene. As mentioned above, a very light liming of the tuquil, not sufficient to interfere with the edibility of the product, checks the yeast but does not prevent inversion. A heavier liming, as advised by Gibbs,[10] necessitates subsequent removal of lime from the tuba. In March, 1920, an experiment was conducted to test the effectiveness of heavy liming. The tuba was collected in Pampanga and transported to Manila for removal of the lime and boiling to sugar.

TABLE 2.—*Collection data on limed tuba.*

	Group.			
	A	B	C	D
Age of stalk ....days..	65	45	30	2
Number of palms	34	31	55	90
Duration of experiment..........days..	16	13	9	9
Average daily yield per palm..........cc..	630	773	581	500
Sucrose..........per cent..	9.0	10.1	9.1	10.7
Alkalinity (as CaO)..........do....	1.3	1.4	1.4	1.3
Unlimed..........per cent sucrose..	12.0	....	14.9	14.6

Preservative.—Due to the tendency of lime to sink to the bottom of the tuquil and allow the top layers of tuba to become acid, it was found necessary to use very heavy liming or else collect twice a day. A thick lime cream was made of density 50° Baumé, containing about 600 grams of lime (calculated as calcium oxide) and 25 grams of sodium bisulphite per liter. A liter of this mixture was poured into each tuquil and poured out again, about 200 cubic centimeters adhering to the tuquil. The tuquil was then placed horizontally and allowed to dry. The liming was done at a central place to which the used tuquils

[9] Op. cit. 124.

[10] Loc. cit.

were brought every day, and a freshly limed tuquil was placed every day on each palm after collection of the tuba. By this very thorough liming good preservation was obtained, and the top layers of tuba in each tuquil were almost always found alkaline to litmus even when collected at twenty-four-hour intervals.

The collection data are summarized in Table 2, in which the palms are grouped according to the age of the stalk; that is, the number of days that elapsed between the cutting of the fruit and the beginning of the experimental collection. The unlimed tuba mentioned in the last line of Table 2 was collected at about the end of the experimental period from ten representative palms in each group. Its collection, under toluene, has been described above.

The limed tuba was stored in wooden barrels for about a month before boiling to sugar, during which time absolutely no decrease in polarization could be detected. The alkalinity also was practically constant, but fell off about 0.1 per cent in a barrel of mixed A and B tuba.

It is evident that lime is more effective than toluene in preventing inversion on long storage. The discrepancy between the original values of the limed and the unlimed tuba is therefore surprising. It is partly due to the diluting effect of the lime cream, and perhaps partly to the formation of insoluble lime sucrate. For this and other reasons, such as the accumulation of lime on the tuquils, it was decided that such heavy liming was not practical. This point will be discussed later in connection with the use of funnels.

Manufacture of sugar.—After transportation to Manila the barreled tuba was freed from lime by carbonatation with compressed carbon dioxide and boiled to massecuite in a crude vacuum evaporator. The data on the sugar making[11] are given in Tables 3 and 4. In all 844 liters of tuba were boiled down, and 67 kilograms of sugar polarizing at 87 per cent were obtained. No difficulty was found in refining a portion of this sugar to a pure white product.

COLLECTION WITH FUNNELS

The disadvantages of very heavy liming have already been pointed out. If a thin lime cream is used to line the tuquils, however, the top layers of tuba in some of the tuquils become acid and ferment several hours before collection. Aside from the attendant loss of sugar the organic acid thus formed holds lime

[11] This work was done with the assistance of Mr. Salvador Sevilla.

TABLE 3.—*Manufacture of first sugars.*

	Run No.—						Total.
	1	2	3	4	5	6	
From tuba (chiefly)	B	A, B	A, B	A	C	D	
Total ... liters	181	80	120	90	188	185	884
Sucrose ... grams per liter	119	107	107	108	133	125	115
Sugar obtained ... kilograms	12.9	3.3	5.55	none	12.95	12.65	54.35
Sugar ... grams per liter	71	41	47	0	69	106	64
Polarization	89.6	90.5	91.6	--------	89.1	88.9	89.5
Clerget sucrose ... per cent	89.3	90.1	91.7	--------	89.1	88.5	89.3
Sucrose recovered per liter of tuba ... grams	63	37	43	--------	61	94	57
Yield ... per cent	53	35	40	0	54	75	50
Molasses ... kilograms	7.65	9.05	9.45	15.45	11.93	10.55	64.1
Molasses per liter ... grams	42	113	79	172	64	57	76
Polarization ... degrees	46.7	46.5	45.5	50.6	48.3	45.7	47.4
Clerget sucrose ... per cent	42.3	41.1	41.1	47.4	47.0	44.2	44.4
Molasses sucrose per liter of tuba ... grams	18	46	32	82	30	25	34
Lost sucrose per liter of tuba	38	24	32	26	22	6	24
Brix of molasses	81.5	78.5	75.8	--------	80.8	82.3	79.9
Total solid in molasses	78.9	70.7	75.4	--------	79.2	77.9	76.6
True purity	53	58	54	--------	59	57	56.6

TABLE 4.—*Manufacture of second sugars.*

	Run.			Total.
	a	*b*	*c*	
Molasses taken ... kilograms	--------	--------	--------	64.1
Sucrose ... per cent	--------	--------	--------	44.4
Brix	--------	--------	--------	[a] 80
Total solid ... per cent	--------	--------	--------	[a] 77
Sugar obtained ... kilograms	2.15	3.3	7.15	12.6
Polarization	85.2	83.9	68.5	75.3
Clerget sucrose ... per cent	85.2	84.4	62.4	72.0
Sugar per liter of tuba ... grams	--------	--------	--------	15
Sucrose per liter of tuba ... do	--------	--------	--------	11
Final molasses ... kilograms	9.75	12.25	15.45	37.45
Polarization	45.9	39.2	39.9	41.2
Clerget sucrose ... per cent	42.4	37.2	38.1	38.9
Sucrose per liter of tuba ... grams	--------	--------	--------	17
Brix	83.7	83.9	82.5	86.1
Total solid ... per cent	80.2	79.5	77.7	79.0
True purity	53	47	48	49.0
Original sucrose in final molasses ... per cent	--------	--------	--------	15

[a] Approximate.

in solution which cannot be removed by carbonatation and interferes in the sugar boiling. Pratt[12] has pointed out that this is caused, not by insufficiency of lime, but by the fact that the lime sinks to the bottom and does not mix with the tuba. The use of funnels to lead the tuba to the bottom as recommended by him was found to be quite successful in reducing the lime required to a very small amount. The difficulty encountered was in the adjustment of the tuquil so as to cause all of the tuba to flow through the funnel. When the tuba drips nicely from the end of the stalk the funnel catches it, but tuba which runs down along the stalk seldom enters the funnel but either is lost entirely or runs down the inside wall of the tuquil. When even a few of the tuquils become contaminated with acid top layers in this manner, the resulting mixture is of poor quality.

A slight modification in the manner of attaching the tuquil funnel was found to obviate this difficulty. The new type of tuquil is not pierced with a hole for the stalk but is suspended by means of a piece of ordinary telegraph or heavy fence wire. Under the stalk, near the end, a small bib of galvanized iron catches all the tuba and drops it into the funnel. The wire is firmly held to the stalk by a wood or bamboo wedge placed between the upper loops of the wire and the stalk. The arrangement is clearly shown in Plate 3, figs. 1 and 2.

The cost of a funnel top, made from second-group lumber on a turning lathe, is about 20 centavos. This is very durable, especially if impregnated with paraffin before use. The stem, of small bamboo such as caña bojo, costs practically nothing. The hanger costs about 5 centavos, including the labor of making. The time required for attaching and detaching the hanger is somewhat more than for the simplest native method of attachment, but not so long as for the more complicated methods in use in certain places. The simplest method is to make a small hole in the tuquil, which fits so tightly on the stalk that no fastening is required. As this method has certain faults, such as frequent splitting of the tuquils, and loss of the same by tidal action, it is often supplemented with various devices, even to the extent of tying the tuquil to the stalk, which takes considerably more time than the attachment of the wire hanger.

SMALL-SCALE MANUFACTURE OF NIPA SUGAR

The tuquil hanger above described was developed during a series of experiments at Capiz, Panay, and at Catarman, Samar, on a practical method for open-pan boiling of nipa sap. The previous nipa-sugar experiments of the Bureau of Science have tended more toward testing the suitability of tuba for large-scale sugar-mill methods than to the development of the industry in a small way. A large investment of capital in a nipa swamp on the basis of laboratory data alone, however, would be unsafe, and our recent efforts have been to develop a method that would be feasible on a small scale with a small investment.

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[12] Op. cit. 392.

The use of open pans, or *cauas*, instead of vacuum apparatus makes the boiling house inexpensive, but the replacement of a large-scale carbonatation equipment by home-made apparatus is more of a problem. The Indian method of using so little lime that it need not be removed does not seem efficacious in Philippine nipa swamps, so carbonatation or some equivalent process must be employed.

A small-scale carbonatation outfit recently set up at Catarman is shown in Plate 3, fig. 3. Charcoal is burned in a tight clay stove, a small blacksmith's forge supplying the draft. The fumes are conducted through a 10-inch stovepipe filled with stones. Limed tuba is allowed to trickle down this tower, the same tuba being run through about four times. The carbon dioxide from the burning charcoal precipitates the lime as carbonate, and the heat is generally sufficient to cause the precipitate to flocculate, or "break," especially if the tuba is run through slowly the last time. The hot liquid is filtered through sand placed in kerosene cans having pierced bottoms, and the clear filtrate boiled down in open pans.

The yield of crystalline sugar at the Catarman plant has so far not been good, apparently because of the low-grade tuba from the wild swamp there. The study of tuba variation and of small-scale utilization of tuba is being continued.

Acknowledgments and thanks are due to Ayala & Co.; Mr. José Hernández, of Capiz; and Mr. Wiren, of the Catarman Agricultural School, for the coöperation which has made possible the experiments mentioned in this paper.

ILLUSTRATIONS

PLATE 1

FIG. 1. A nipa seedling.
   2. A two-year-old nipa palm. The seed and first leaf can be seen at the right of the clump of leaf stalks.
   3. A typical mature palm. The clumps in the foreground and in the center of the background were originally the same plant. A month or two previous to the picture the portion at the left had been razed nearly to the ground, but the plant is rapidly recovering.

PLATE 2

FIG. 1. Typical mixed vegetation at Catarman. A deep tidal stream is responsible for the nipa in the center of the picture.
   2. Nipa growing on a steep bank. The same tidal stream as in fig. 1.
   3. Another portion of the bank shown in fig. 2.

PLATE 3

FIG. 1. Tuquils with wire hangers, on crowded nipa bank.
   2. Typical palm, with wired tuquils.
   3. Simple carbonatation apparatus. Evaporating furnace in background.

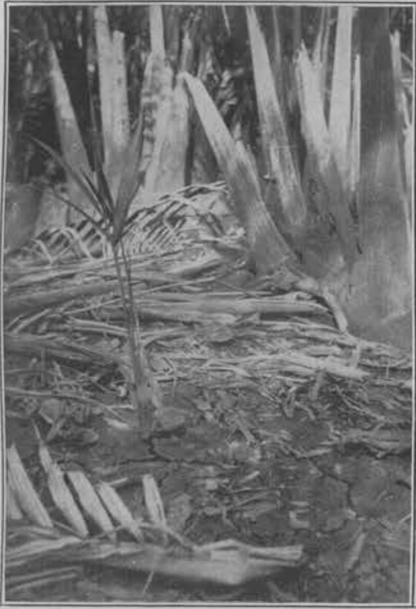

Fig. 1. A nipa seedling.

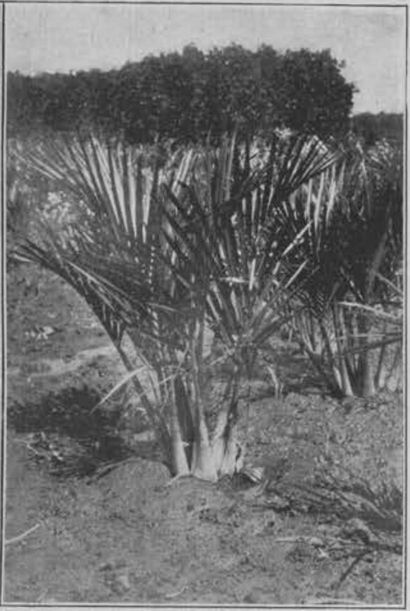

Fig. 2. A two-year-old nipa palm; the seed and the first leaf can be seen at the right of the clump of leaf stalks.

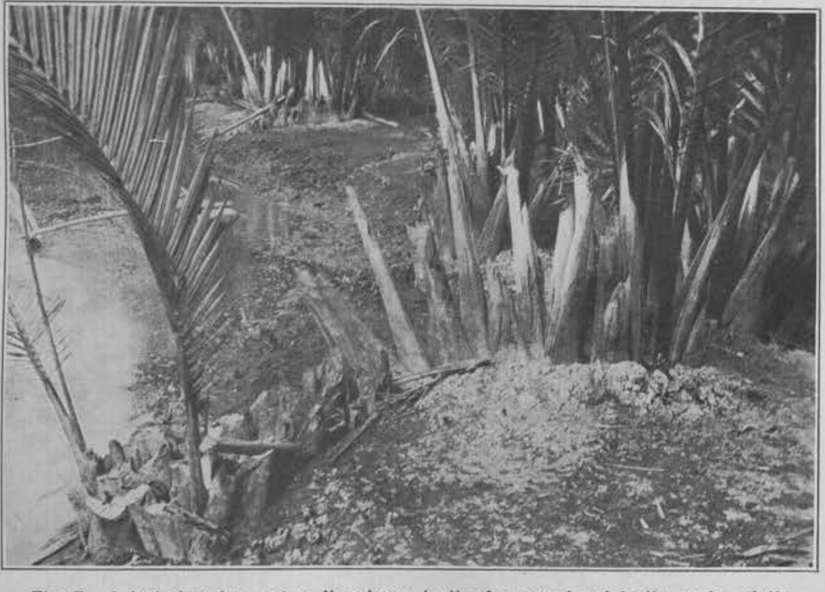

Fig. 3. A typical mature palm; the clumps in the foreground and in the center of the background were originally the same plant.

PLATE 1.

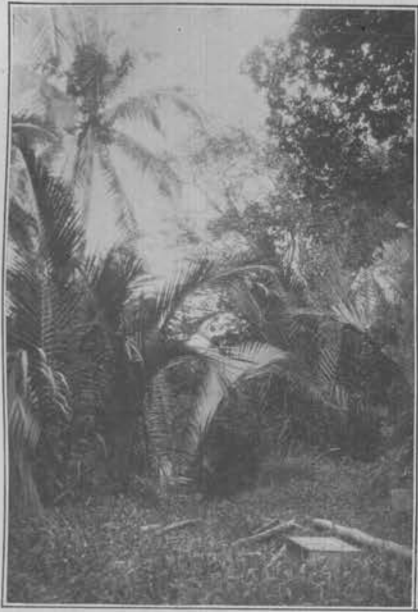

Fig. 1. Typical mixed vegetation at Catarman; a deep tidal stream is responsible for the nipa in the center.

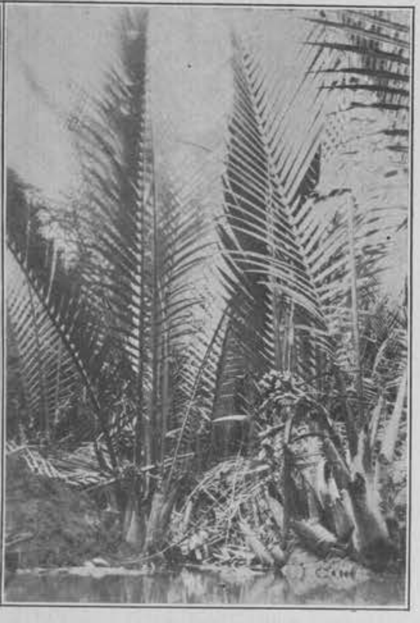

Fig. 2. Nipa growing on a steep bank; the same tidal stream as in fig. 1.

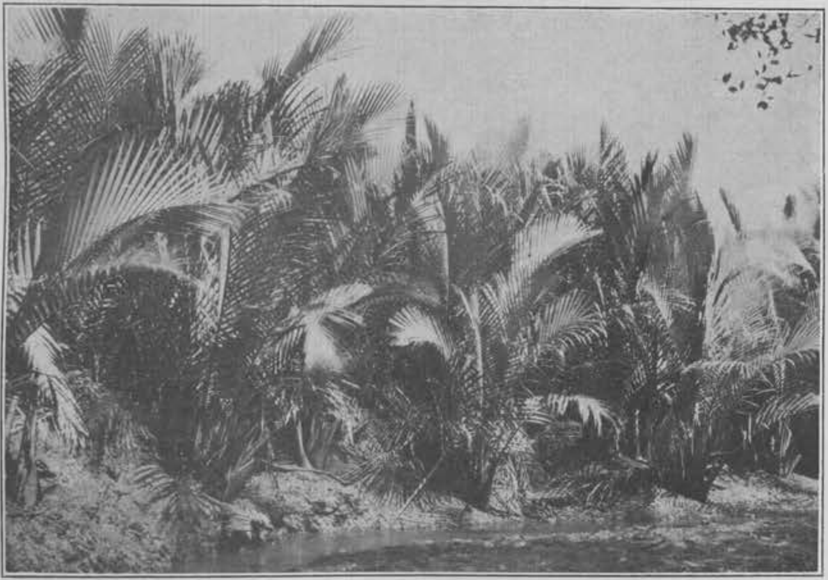

Fig. 3. Another portion of the bank shown in fig. 2.

PLATE 2.

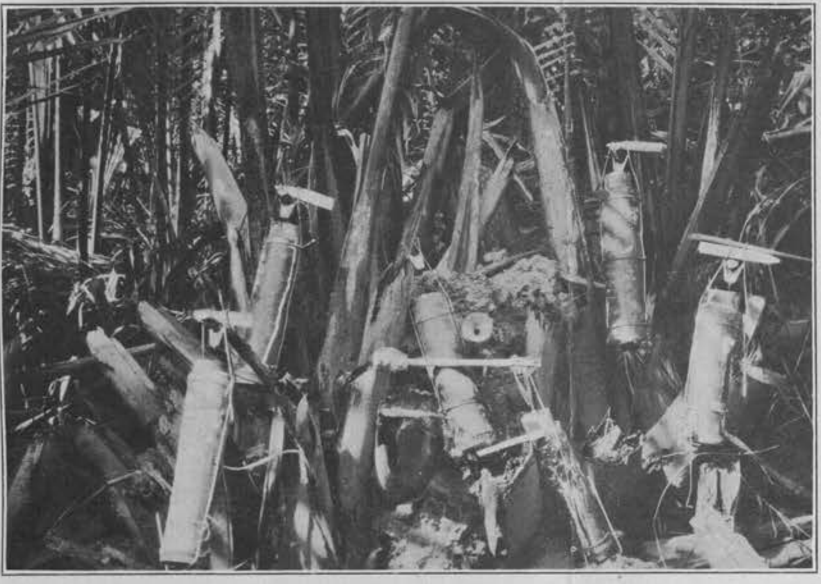

Fig. 1. Tuquils with wire hangers, on crowded nipa bank.

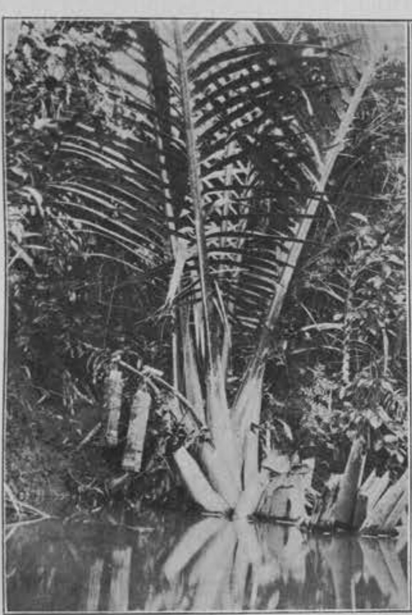

Fig. 2. Typical palm, with wired tuquils.

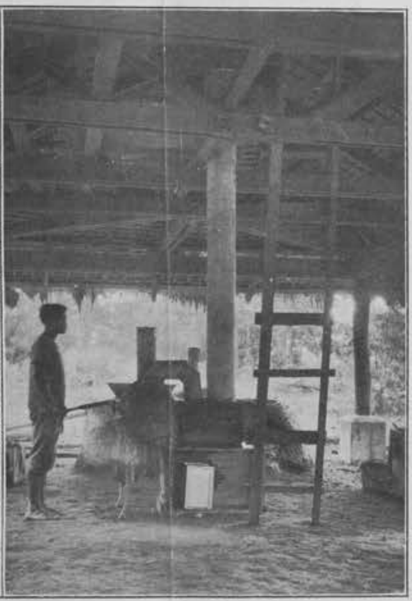

Fig. 3. Simple carbonatation apparatus; evaporating furnace in background.

PLATE 3.

DRAINAGE CONTROL BY JOINTING IN ANGAT DISTRICT, BULACAN PROVINCE, PHILIPPINE ISLANDS

By HUBERT G. SCHENCK

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TWO PLATES

In making the trip north from Montalban, Rizal Province, to Angat River, Bulacan Province, Luzon, one is impressed from a distance by the nearly uniform elevation of the ridges and hilltops, and upon his first sight of Angat River the observer is apt to conclude that here is an old-age stream rejuvenated, judging from what appear to be numerous intrenched meanders, and that the country was once peneplained. A study of the topographic map of the region (Plate 1) apparently confirms this first field impression, for the hills vary from 300 to 400 meters in height, and winding rivers are evidenced. However, field work tends to disprove any theory of peneplanation that might be set forth and indicates instead that the drainage, in a limited area at least, is controlled by a definite system of joints in igneous rocks. It is the purpose of this paper to give reasons for this interpretation.

The field work upon which this paper is based was limited to an area between Montalban on the south and Angat River on the north (chiefly from Paila to Papaya on Angat River), while the writer was a member of a geologic party investigating a proposed dam site for the Metropolitan Water District of Manila. The region is essentially an igneous one, although some Miocene limestone outcrops in Ipu River, at Papaya, near Pinagkamalejan Barrio (Pinagkamaligan) between Ipu and Paila, and near Sicao. The principal rocks, however, are andesites, andesitic agglomerate, and basalts, though diorite and silicified intrusive masses are known. Most of the igneous formations are younger than the Miocene limestone.

The immediate area under discussion is not one of high relief, few peaks reaching a height of more than 400 meters, while the lowest valleys have elevations ranging around 100 meters above sea level. To the east rise the high peaks of the Eastern Cordillera. The soil is residual, except in a few favorable places in valleys where it is transported. Spurs are usually of hard material. Angat River and all the creeks are youthful. Erosion has taken place in the zone of fracture and carved the earth's surface to that stage of erosional cycle which may be termed early maturity in the andesitic areas and more-advanced maturity in the limestone areas.

To account for the physiography of this limited area, one first tries the idea of peneplanation, and the writer was for some time convinced that this was the proper interpretation of the land forms. The reason for suggesting the theory at this time is that base levels have been suggested in the plateaus of northern Luzon and elsewhere, and it is possible that a discussion in the nature of the present paper might fit into a general scheme where there may be several such base levels; or, on the other hand, it might explain certain land features by other means than by that of peneplanation. The six principal criteria, or evidences, of peneplanation are deep rock weathering, absence of ledges, absence of undrained areas, monadnocks, lack of interruption of peneplain surface on rocks of different resistance, and old-age drainage. Considering these separately, it is found that:

1. This criterion of peneplanation cannot be relied upon in the Tropics where weathering is normally very deep.

2. Ledges in this district are very abundant, and are quite evident, even though there is the usual tropical vegetation. This also does not apply in the district under discussion.

3. This section is well drained, and no undrained areas were noted, as might be expected.

4. A monadnock is an erosional remnant, usually of resistant material, left standing during the process of a river's reaching base level. No monadnocks were seen, and the idea that Mount Mararat might be such is not plausible, since it does not have the softened contours of a monadnock, but is probably a mass of andesite of the same age as the formation in which the river is to-day entrenched.

5. This cannot be stated definitely but is based on good evidence that some of the ridges extant are of a hard, silicified material, while some are harder and more resistant than the other rocks and have been, and are being, eroded faster than the more durable formations, indicating an interruption of a peneplain surface.

6. That Angat River meanders to a very large extent and bears a superficial resemblance to a rejuvenated old-age stream cannot be gainsaid, though it should be pointed out that the elbow bends made by the river are not true old-age meanders, while the apparent uniform level of hilltops is due merely to the removing of burden from the top of a lava flow and the smoothing off of the original surface, and therefore the accordance of tops is not indicative of a peneplain surface. This, nevertheless, is not due to base-leveling during an earlier erosional cycle, but as evidence gained in the field indicates is due to three principal causes; namely, jointing, difference in hardness of rock, and faulting.

The major systems of jointing seem to be northeast–southwest and northwest–southeast with minor north–south and east–west ones, but no reliable general inclinations of the systems were observed, nor could the spacing be determined in so short a time. The joints are frequently stained by iron oxide and, at places, are very definite. Ickis[1] found that the jointing of the andesite in Agos River from Infanta as far west as Macadata was about north 75° east, with a dip of 75° to the southeast, and that there are also joints that strike nearly at right angles to these and dip steeply to the northeast. The same observer also records joints striking north 20° west to north 70° east. The joint system in the vicinity of Paila, as noted by the present writer, varies from north 20° west to north 40° west, and at right angles thereto. Near Papaya, the major jointing appears to be north 50° east to north 60° east. At the head of a creek near Paila, a good north 35° west joint was noted, while in a creek near Metropolitan Dam Site 2 there is a good example of the northeast joint system. Below Dam Site 1, the river turns sharply north 30° west after cutting a northeast box cañon through a hard, silicified dike.[2] Other examples of this feature might be pointed out, and the writer believes that the main drainage is roughly parallel to the major systems of jointing and is largely controlled by them.

The second cause of the apparent old-age drainage of Angat River is difference in hardness of rock. Incipient stream capture is hindered, if not prevented, by this. For example, if the creek at Dam Site 2 could work headwards with ease, it might capture Sapang[3] San Lorenzo and also the drainage of the main river, but this is partly prevented by hard, silicified andesite that acts as the divide here. A hard dike turns the river near Paila between Dam Sites 1 and 2, as is shown on the map. As a rule bends in the river are actually more abrupt than shown on the map.

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[1] Ickis, H. M., A geological reconnaissance from Infanta, Tayabas, to Tanay, Rizal, Philip. Journ. Sci. § A 4 (1909) 483–487.

[2] This detail does not show on the map presented herewith, because the map is more or less generalized.

As a third important cause of the extraordinarily abrupt bends of Angat River, one must record faulting and the fact that the faults may be in conformity with the joint system. Faulting probably accounts for the short change of course upstream about 6 kilometers from Papaya, where the long southwest flow is changed for a short distance only, and where other evidences of faulting are to be noted.

These three causes of drainage control have combined with one another at places to bring about the present land forms. At the entrance of the gorge below Paila, at Dam Site 1 (Plate 2, figs. 1 and 2) the jointing is north 30° west, as is likewise the strike of beds of andesite and agglomerate, and here, working up a joint in the least resistant material, is a small stream, showing that erosion is aided by both the nature of the rock and the joints. At another place near Ipu River a valley is developing along what appears to be a fault, while at still another locality (near the dam sites) a fault parallels the jointing and reenforces the joint-system control. But when all is considered and more observations are recorded, the writer believes that jointing will best explain the majority of drainage features.

These systems of jointing are by no means unusual, for it is well known that there is a tendency for fractures to intersect at right angles to one another and for all the sets to be at about 45° to the direction of compression. It is, however, in the world relationships that the northwest–southeast and northeast–southwest jointing of Angat district is most interesting. For instance, Iddings[4] records similar drainage control in the region north of the Yellowstone National Park in the United States, while Hobbs[5] discusses this matter of structural control of drainage (and the influence which Hobbs considers predominant in Europe and Africa is practically the same as the jointing observed by the writer in this locality in the Philippines) and concludes that a recognition of such a fracture system "points inevitably to the conclusion that more or less uniform conditions of stress and strain have been common to probably the earth's entire outer shell."

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[3] *Sapa*, becoming *sapang* in combination, is Tagalog for "creek."

[4] Iddings, J. P., A fracture valley system, Journ. Geol. 12 (1904) 94–105.

[5] Repeating patterns in the relief and in the structure of the land, Bull. Geol. Soc. Am. 22 (1911) 123–176.

It might be argued that the three factors of drainage control discussed herein are perhaps subsidiary to a main control; namely, that the entire river is not controlled by jointing, faulting, and differential hardness of rock, but by other factors such as antecedency and superimposition, taking as evidence for this stand the general south course of the river and the turn it makes to the west later. Another criticism that can well be advanced is that not enough territory was covered to gain an idea of the entire area. The writer admits the truth of these points, but he desires to make it clear that he is convinced that in the small, limited district in question northwest–southeast and northeast–southwest jointing systems, aided by faulting and hardness of rock, control the drainage, and that here this peculiar feature is not the result of peneplanation and subsequent rejuvenation.

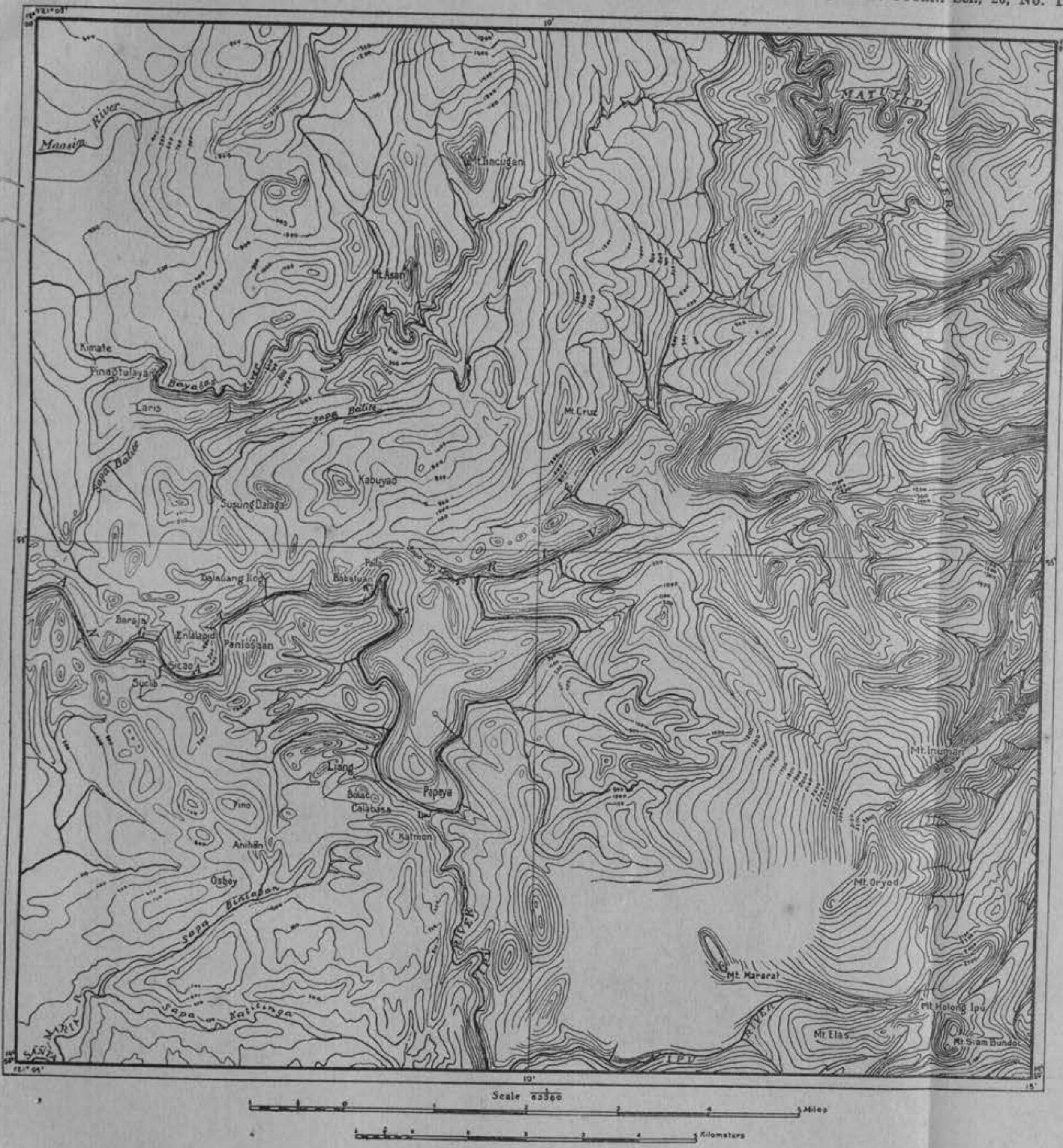
ILLUSTRATIONS

PLATE 1

Topographic map of Angat district.

PLATE 2

FIG. 1. Angat River, looking westward toward Dam Site 1, where the river cuts a box cañon and turns sharply north 30° west.
2. Angat River, Dam Site 1.



Contour interval 100 feet

PLATE 1. TOPOGRAPHIC MAP OF ANGAT DISTRICT.

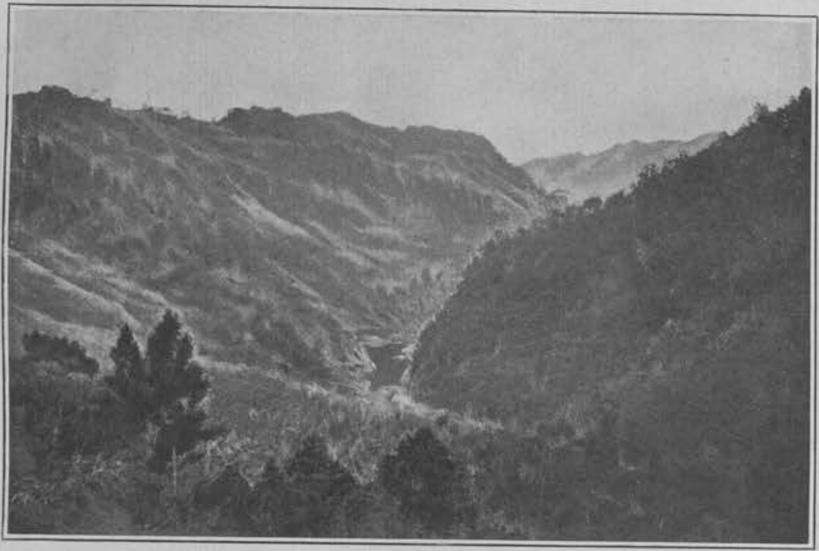


Fig. 1. Angat River, looking westward toward Dam Site 1, where the river cuts a box cañon and turns sharply north 30° west.

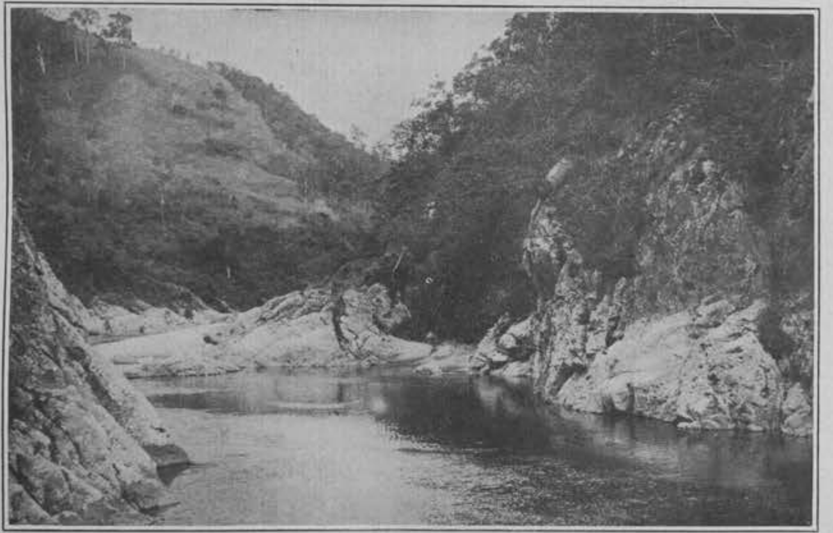


Fig. 2. Angat River, Dam Site 1.

PLATE 2.

PHILIPPINE SERPHIDÆ (PROCTOTRUPIDÆ)

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[Translated from the German by Anna B. Banyea, of the Bureau of Science, Manila]

BETHYLIDÆ

The species here described were collected by Prof. C. F. Baker, in the Philippines, on the islands of Luzon, Mindanao, Negros, Leyte, and Palawan.

ANTEONINÆ (DRYININÆ)

Genus **ALLODRYINUS** novum

Head strongly oblique, slightly convex dorsally. Eye bare. Palpi very short, only one short joint prominent. Antennæ 10-jointed, distally hirsute. Prothorax almost cylindrical, elongate, much longer than mesonotum, this strongly transverse, with continuous parapsidal furrows which diverge in front and are separated from each other posteriorly by three times their breadth. Scutellum in front with a deep cross furrow. Metanotum depressed, forming a narrow cross stripe. Median segment horizontal, nearly as long as broad, dorsal surface traversed by a deep, broad, median groove; smooth and shining laterally and divided into areas by a few raised lines. Posterior surface almost vertical, separated from the anterior surface by an irregular transverse carina, with a large, median, longitudinal area and laterally one or two smaller areas. Venation as in *Lestodryinus*. Pterostigma very narrow, lanceolate.

Front leg extraordinarily long, extending much beyond abdomen, coxa obconical, as long as femur; trochanter also as long as femur, thin, pedicellate, thickened in the distal half; femur shaped like coxa, tibia thin, gradually thickened in the distal half, tarsus longer than tibia, first and fourth joints long, fourth longer than the first three combined, fifth small, chelæ slender, extending to third joint, both branches of chelæ almost straight, incurved at end, without tooth but with rows of lamellæ or spines, median branch (which is a continuation of fifth tarsal joint) with truncate lamellæ, without spines, lateral branch, which is the inflexed claw, with about ten spines equidistant from each other, with much longer, curved bristles on the inflexed distal end.

Type, *Allodryinus miripes* sp. nov.

Allodryinus miripes sp. nov.

Female.—Black, shining, smooth. Head whitish, dorsally black from posterior margin to opposite anterior third of eye, the black marking arcuate in front, truncate behind. Viewed from above the head is strongly transverse, almost twice as broad as long and almost twice as broad as prothorax, dorsally slightly convex, marginate behind, the entire posterior margin strongly curved and notched, occiput sloping and excavated. Vertex and frons at least as broad as length of eyes. Cheek one-fourth as long as eye, with fine, silvery white hairs like the anterior part of frons. Eyes more than twice as long as broad, weakly divergent behind. Ocelli forming an equilateral triangle. Mandible whitish, with three brownish teeth. Antenna 4 millimeters long, very thin, first and second joints whitish, second fully two to three times as long as thick, third taking in more than one-third of the entire flagellum, sixth as long as the following three united, ninth twice as long as thick, shorter than tenth, seventh to tenth hirsute, the hairs longer than the thickness of joints.

Prosternum whitish, a small, circular spot behind on pronotum as well as scutellum yellowish. Prothorax almost cylindrical, twice as long as broad, the posterior margin extending laterally lobelike to tegula. Mesonotum twice as broad as long, very finely punctured, parapsidal furrows diverging anteriorly, separated from each other posteriorly by three times their breadth. Cross furrow of scutellum black. Wings hyaline, pterostigma very long and narrow, radial curved, long, reaching almost to anterior margin, postmarginal slightly shorter than radial, basal oblique, twice as long as transversal, arising in the distal end of subcostal, nervule nearly vertical, medial extending somewhat beyond basal cells.

Legs whitish to pale yellow, almost transparent, foreleg much longer than body, 8 millimeters long, petiole of hind femur a little shorter than the clava, tibia almost filiform, longer than femur. Abdomen as long as rest of body, venter testaceous.

Length, 5 millimeters.

MINDANAO, Butuan.

Genus **HAPLOGONATOPUS** Perkins

Haplogonatopus cristatus sp. nov.

Female.—Black, smooth and shining. Head more than twice as broad as long, strongly excavated dorsally, with a continuous median longitudinal carina, notched and arcuate posteriorly. Eye bare; ocelli wanting; clypeus and mandible white, the latter with three black-brown teeth. Palpi not prominent. Antenna unicolored, scape very much widened ventrally, second joint a little shorter than first, not twice as long as thick, third almost twice as long as first and second combined, distally gradually thicker, fourth gradually thickened, two-thirds as long as third, the following ones of equal thickness, gradually shortened, ninth fully twice as long as thick, shorter than the last one. Thorax much narrower than head, the forward node raised pectinate medially, compressed laterally, anteriorly gradually rising, posteriorly falling away steeply; posterior node oblong, noticeably longer than the anterior, posteriorly coarsely and closely transversely striated, the thorax lightly fastened between both knots. Wings wanting.

Tarsal joints 2 to 4 red-brown; coxa of foreleg elongated, trochanter clavate, half as long as femur, with a long, thin petiole, femur much thickened in the proximal three-quarters; metatarsus long, second, third, and fifth joints very short, fourth at least as long as first, the medial branch of chelæ, or continuation of fifth tarsal joint, reaching distal end of metatarsus, straight, with a row of close lamellæ, incurved at distal end; lateral branch of chelæ curved and tapering in the distal third, without tooth; proximal half with four lamellæ situated equidistant from one another; hind femur thick in proximal third only, shorter than the thin tibia. Abdomen smooth.

Length, 6 millimeters.

NEGROS, Cuernos Mountains.

BETHYLINÆ

Genus **CLADOBETHYLUS** novum

This genus is distinguished from all other Bethylinæ by the shape of the head and of the antenna. Viewed from above the head is somewhat transverse, falling away abruptly in front; seen from in front it is higher than broad at top, gradually narrowing below to the mandibles. Mouth directed downward, mandible narrow, almost lineal, scarcely emarginate at the end. Eye very large, very prominent, almost semiglobose, and bare.

Antenna 13-jointed, originating close behind mouth, geniculate as in the Ceraphroninæ.

Pronotum as broad as mesonotum, quadrangular. Mesonotum with two continuous parapsidal furrows. Scutellum strongly transverse, rounded behind, not impressed in front. Median segment almost horizontal, slightly convex, with two broad crenulated furrows which converge posteriorly and come together at the posterior margin, thus inclosing a three-cornered field, laterally and posteriorly bordered by a crenulated groove; posterior surface almost vertical. Venation of forewing as in *Epyris*, but radial shorter; hind wing without veins, lobed behind. Legs as in *Epyris*, claw very small. Abdomen flat, shorter than usual, elliptic, petiole very small, originating between hind coxæ, second tergite falling away in front almost vertically, third scarcely longer than second, the three following ones short.

Type, *Cladobethylus cruciger* sp. nov.

Key to the species of Cladobethylus g. nov.

a^1. Head and thorax black, without metallic sheen, hind tibia bare. C. myrmecophilus sp. nov.

a^2. Head and thorax blue, with metallic sheen, hind tibia with long hairs dorsally.

  b^1. Head with a smooth median longitudinal line, postmarginal wanting, third tergite without punctation.......... C. cruciger sp. nov.

  b^2. Head without smooth longitudinal line, postmarginal present, third tergite closely punctured.......... C. cœruleus sp. nov.

Cladobethylus myrmecophilus sp. nov.

Male.—Black, smooth, shining; face and mouthparts yellow, palpi and legs whitish, almost transparent, second antennal joint, posterior margin of scutellum, petiole, and second tergite red-brown. Head with few coarse punctures, quadrangular when viewed from above, slightly transverse, scarcely broader than thorax, falling away almost vertically in front to antennæ and gradually narrowing, laterally higher than long. Eye bare, large, round, as wide as frons, almost reaching posterior margin of head. Posterior ocelli opposite middle of eye, separated from eye by their diameter, widely separated from posterior margin of head. Cheek almost lacking. Palpi very small. Antenna geniculate, as long as body, thin, filiform, scape scarcely shorter than third joint, second joint very small, bare, little longer than thick, third to thirteenth with short hairs, gradually becoming thinner and shorter, third fully five times as long as thick, twelfth scarcely three times, thirteenth a little longer.

Thorax almost three times as long as high, sublinear. Pronotum quadrangular, transverse, slightly convex. Mesonotum as long as pronotum, quadrangular, with continuous, parallel, widely separated parapsidal furrows. Mesopleura coarsely, scatteredly punctured. Scutellum transverse, two-thirds as long as mesonotum, quadrangular. Metanotum lacking. Median segment opaque, irregularly rugose, not edged, but convex laterally and posteriorly, strongly transverse, as high and as broad as pronotum and mesonotum; two oblique longitudinal striæ from anterior margin to posterior margin, where they join, forming two tiny teeth.

Wing faintly fuscous, subcostal lying close to costal, pterostigma narrow, lanceolate, longer than the short postmarginal, radial very short, only two-thirds as long as basal, extended almost to the anterior margin by a long, curved, pale vena spuria, basal oblique, arising in the thickened end of subcostal, transversal vertical, half as long as basal, medial reaching beyond the basal cells and thus bordering an outer submedian cell above, the two other veins (distal and posterior) bordering it very pale, discoidal continuous, cubital extinct anteriorly, distinct in the distal two-thirds; hind wing shortly lobed, without veins. Legs bare, femora slightly thickened, tarsi slender, 5-jointed. Abdomen rather flat, elliptic, somewhat shorter than thorax, shaped as in the preceding.

Length, 2.8 millimeters.

MINDANAO, Butuan.

A dead ant was found firmly attached to the ventral surface of abdomen. This ant was 1.2 millimeters long, pale yellow; head (exclusive of the quadridentate mandibles and the eleven-jointed antenna) and abdomen (exclusive of petiole and the two knots) black; head quadrangular, somewhat elongate, broader than abdomen; mandible nearly half as long as head; third to eighth joints of antenna transverse and equally thin, ninth to eleventh thickened, eleventh as long as the six preceding ones combined.

Cladobethylus cruciger sp. nov.

Male.—Metallic blue. Head coarsely and rather closely punctured, as broad as thorax. Mandible yellow. Cheek with a deep furrow, half as long as eye, smooth, black and shining, like the anterior part of temple. Eye broader than frons, almost reaching posterior margin of head. Ocelli forming an equilateral triangle, the posterior ones separated from eye by their diameter, from each other by twice their diameter, lying almost opposite middle of eye, more than twice as far from posterior margin of head as from each other. A smooth, longitudinal line connects the anterior ocellus with posterior margin of head, and a smooth crossline connects the posterior ocelli, thus forming a cross. Frons anteriorly with a weak, rather smooth impression. Palpi pale; maxillary palpus at least 4-jointed. Antennæ brown, geniculate behind scape, first and second joints yellow, scape as long as the following two joints together, second joint very small, ring-shaped, the following ones thicker, longer, cylindric, and hirsute, the hairs almost as long as thickness of joints, the third joint fully three and a half times as long as thick, the fourth three times, the following ones gradually shorter, the twelfth more than twice as long as thick, shorter than the last one.

Pronotum and mesonotum coarsely and rather closely punctured, the pronotum somewhat transverse, distinctly longer than mesonotum; this truncate anteriorly and posteriorly, the median part broader than the lateral ones, parapsidal furrows parallel. Scutellum not punctured. Metathorax black, shining; triangular field of median segment smooth, cross-wrinkled laterally, anterior margin of median segment with a row of small pits, posterior vertical surface with two longitudinal carinæ strongly converging downward. Metapleura flat, almost smooth, emerging toothlike above behind the middle; mesopleura convex, coarsely and closely punctured.

Wings faintly fuscous, subcostal near costal; pterostigma lanceolate; radial originating slightly distad of the middle of pterostigma, bow-shaped, proximal portion shorter than basal; distal portion supplanted by a pale, fine line and longer than the proximal portion, almost reaching anterior margin; basal very oblique, curved only at base, three times as long as transversal, arising in the distal end of subcostal; transversal almost vertical; postmarginal wanting; pale lines indicate the following veins and cells; the cubitus sinuous, arising from distal end of basal and reaching margin of wing; a continuation of medial to cubitus; a continuous anal; a closed distal medial cell (cubital cell); and a closed distal submedian cell (discoidal cell). Hind wings with four tiny frenulæ. Legs yellow, femur and tibia of hind leg dorsally with long, spreading hairs. Abdomen black-brown, smooth,, second and third tergites long.

Length, 3.5 millimeters.

MINDANAO, Butuan. LUZON, Laguna, Mount Maquiling.

Cladobethylus cruciger var. antennalis var. nov.

Male.—Scape brown like flagellum, third joint three times as long as thick, fourth only twice as long. Mesonotum as long as pronotum. Triangular field of median segment metallic blue. Distal section of radial forming a distinct, fine vein. Abdomen dark red-brown to black-brown.

Length, 4 millimeters; otherwise like type.

LUZON, Tayabas, Mount Banahao.

Cladobethylus cœruleus sp. nov.

Female.—Like *C. cruciger* with the following exceptions: Head more finely punctured, without smooth longitudinal line or cross-line; posterior ocelli not twice as far from posterior margin of head as from each other; cheek scarcely one-third as long as eye, frontal impression finely cross-striped. Antenna without hairs, third joint two and a half times as long as thick, fourth longer by a half than thick, the following ones gradually thinner, twelfth one and a half times as long as thick, thirteenth more than twice as long as thick. Postmarginal distinct, thicker than radial, somewhat shorter than the proximal section of radial, basal sinuate; veins obsolete in *C. cruciger*, very plainly visible in the present species. Triangular field of median segment metallic blue; the posterior vertical surface traversed by a continuous middle field which is broad and curved-rounded above, and narrowed toward the bottom. The entire third tergite closely and rather finely punctured. Coloring as in *C. cruciger.*

Length, 4 millimeters.

MINDANAO, Butuan.

Genus ISOBRACHIUM A. Förster

a^1. Median segment with 5 longitudinal raised lines. **I. bipunctatum sp. nov.**

a^2. Median segment with 3 longitudinal raised lines. **I. luzonicum sp. nov.**

Isobrachium bipunctatum sp. nov.

Female.—Black. Head elongate, finely hirsute, closely punctured, opaque, much wider than thorax, widest at middle of eyes. Eye finely hirsute, short-elliptic, three times as long as cheek, as long as its distance from posterior margin of head; posterior ocelli touching posterior margin of head; mandible and palpus red-brown. Antenna dark-brown, scape black except the distal end, as long as the three or four following joints together, second joint somewhat elongate, third to twelfth transverse, thirteenth elongate, all bare, second and third joints testaceous.

Pronotum elongate, opaque, closely punctured, somewhat wider behind than in front. Mesonotum scarcely more than half as long as pronotum, smooth, shining, transversely elliptic. Scutellum opaque, very finely punctured, anteriorly with two short oval depressions almost touching each other. Median segment quadrangular, distinctly longer than broad, bordered laterally and posteriorly by a furrow, finely coriaceous, with five parallel, contiguous, longitudinal carinæ in the middle, these somewhat shortened posteriorly, only the medial one continuous.

Wings scarcely fuliginous; basal and transversal equally long and equally sloping, the former originating in the distal end of subcostal; pterostigma linear in shape, the distal half consisting of a white proximal and a brown distal dot, the radial arising from the latter, the radial being three to four times as long as basal, slightly curved. Tegulæ and legs testaceous, coxæ black, femora brown except the distal end. Abdomen convex, smooth, shining, gradually tapering to a point.

Length, 3 millimeters.

MINDANAO, Butuan.

Isobrachium luzonicum sp. nov.

Female.—Black. Head almost circular, scarcely longer than broad, smooth, shining, with few close punctures, eye hirsute, one-third longer than occiput; palpi pale. Antenna dark red-brown to brown-black, bare; scape as long as the three following joints together, second joint somewhat elongate, third to twelfth scarcely as long as thick, thirteenth oblong. Pronotum somewhat longer than broad, smooth, shining, with rather large but not very close punctures.

Mesonotum two-thirds as long as pronotum, anterior half smooth, without punctures, posterior half finely and rather closely punctured. Scutellum without punctures, smooth and shining, the depressions separated from one another by a carina. Median segment as long as broad, transversely rugose, marginate laterally and posteriorly, with three continuous, contiguous longitudinal carinæ slightly converging behind; posterior surface vertical, smooth, with a median longitudinal carina. Mesopleura with few punctures; metapleura almost smooth. Wings slightly fuliginous; subcostal near to costal; pterostigma narrow, three times as long as broad, the proximal third white; postmarginal wanting, basal oblique, originating in the distal end of subcostal; radial three times as long as basal, transversal as long and as slanting as basal. Tibiæ and tarsi red; femora of the four hind legs black-brown, middle tibia laterally with short spines. Abdomen convex, conically tapering behind.

Length, 3 millimeters.

LUZON, Laguna, Mount Maquiling.

Genus **MESITIUS** Spinola

Mesitius philippinensis sp. nov.

Male.—Black. Like *M. luzonicus* Kieff.[1] except for the following markings; the coarse punctures of the head umbilicate; fourth to thirteenth joints of antenna more than twice as long as thick. Wings brownish, with a lighter crossband from pterostigma to posterior margin, veins and pterostigma black-brown. Legs black-brown, distal end of tibiæ and tarsi yellow; only the posterior fifth of third tergite without punctures, the two filiform appendages of the last segment converging.

Length, 3.5 millimeters.

MINDANAO, Dapitan.

Genus **CLEISTEPYRIS** Kieffer

- a^1. Mandible much widened distally, 4- or 5-toothed; clypeus rounded in front or truncate.
  - b^1. Veins and pterostigma pale yellow; postmarginal as long as pterostigma; twelfth antennal joint fully five times as long as thick.
    - c^1. Claw with one small tooth; the four proximal antennal joints brownish yellow .... **C. intricatus** sp. nov.
    - c^2. Claw with a large tooth, almost furcate; distal end of scape and second joint reddish brown .... **C. xanthopterus** sp. nov.
  - b^2. Pterostigma as well as the greater part of veins black-brown.
    - d^1. Postmarginal much shorter than pterostigma; median segment without longitudinal carina; 6 to 9 millimeters long.
      - e^1. Head with thimblelike punctures; pronotum and mesonotum rather closely punctured; twelfth antennal joint not three times as long as thick .... **C. philippinensis** Kieff.
      - e^2. Head without thimblelike punctures, the punctures rather close but not touching; pronotum and mesonotum with but few scattered punctures; twelfth antennal joint at least four times as long as thick .... **C. consobrinus** sp. nov.
    - d^2. Postmarginal twice as long as pterostigma; median segment with a longitudinal carina; 3 to 5 millimeters long. **C. minimus** Kieff.

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[1] Tierreich 41 (1914) 304.

a^2. Mandible almost linear, distally scarcely broader, obliquely truncate, and terminating in a single pointed tooth; clypeus triangular, strongly keeled, sharply projecting in front.................. C. minor Kieff.

Cleistepyris intricatus sp. nov.

Male.—Black, smooth, shining. Head almost circular, scarcely longer than broad, rather closely and coarsely punctured; eye bare, somewhat longer than occiput, posterior ocelli twice as far from posterior margin of head as from each other; cheek almost wanting. Clypeus keeled, truncate anteriorly. Mandible dark red-brown, distally very broad, coarsely punctured, with four or five dark-brown teeth which gradually increase in length from top to bottom. Palpi pale, maxillary palpus with five prominent joints. Antenna filiform, the four proximal joints brownish yellow; scape as long as second and third joints together, second joint bare, shining, almost annular, third little longer than fourth, this somewhat more than twice as long as thick, the following ones like the fourth, distal joints gradually becoming thinner, twelfth fully five times as long as thick, scarcely shorter than thirteenth; hairs almost as long as the thickness of joints, longer on distal joints.

Pronotum much widened dorsad, scarcely longer than mesonotum, both with few scattered punctures; parapsidal furrows parallel, not distinctly widened behind and not reaching the posterior margin. Scutellum without punctures, the cross furrow slightly curved, somewhat broader at both ends. Metanotum coarsely rugose. Median segment scarcely transverse, very coarsely intricately wrinkled, marginate laterally, not so posteriorly, posterior surface not vertical, coarsely intricately wrinkled and without a median longitudinal carina. Metapleura closely striped longitudinally; mesopleura scatteredly punctured.

Wings hyaline, with white branched lines; pterostigma lanceolate, yellow like the veins, white at base; postmarginal as long as pterostigma; basal very slanting, originating in the thickened distal end of subcostal; transversal slanting, shorter than basal; radial scarcely twice as long as basal; distal submedian cell bordered by pale venation. Tegulæ and legs testaceous; coxæ black; hind femora black-brown; femora slightly thickened; legs finely hirsute, joints of fore tarsus elongate, not heart-shaped; claw with one small tooth. Abdomen slightly convex, gradually narrowing behind, without punctures.

Length, 6 millimeters.

LUZON, Laguna, Mount Maquiling.

Cleistepyris xanthopterus sp. nov.

Male.—Black; mandible, distal end of scape, and second antennal joint red-brown; foreleg and middle leg testaceous, hind leg, coxa, and femur of middle leg black-brown. Median segment less coarsely wrinkled, with three shortened longitudinal wrinkles. Metapleura intricately wrinkled. Wings yellowish. Claw with one large tooth, almost furcate. Otherwise, like the preceding species.

Length, 6.5 millimeters.

LUZON, Tayabas, Mount Banahao.

Cleistepyris philippinensis Kieff.

LUZON, Laguna, Los Baños, Mount Maquiling, Pagsanhan: Tayabas, Mount Banahao.

Cleistepyris consobrinus sp. nov.

Male.—Black. Mandible, distal end of scape, and second antennal segment red-brown; palpi pale; flagellum black-brown; tarsi and fore tibiæ testaceous.

This species is closely related to *C. philippinensis;* in both species the clypeus is only slightly keeled, broadly rounded in front; the mandible very much widened distally, coarsely wrinkled, and 4- or 5-toothed; the antenna closely white-haired; the parapsidal furrows almost parallel, somewhat widened behind and not reaching posterior margin; and the postmarginal much shorter than the pterostigma. *C. consobrinus* however is differentiated by the following markings: The head is not punctured thimblelike as in *C. philippinensis,* but has a few close punctures which do not touch each other. Antenna longer, thinner distally, third joint more than twice as long as thick, twelfth at least four times as long as thick, whereas in *C. philippinensis* it is not three times as long as thick. Pronotum, mesonotum, and scutellum smooth, with several scattered punctures. Veins of distal submedian cell very pale. Abdomen without red marking, whereas in *C. philippinensis* the posterior margin of second tergite is more or less red-brown.

Length, 6 millimeters.

LUZON, Tayabas, Mount Banahao.

Cleistepyris minimus Kieff.

Male.—In this species mandible and clypeus are shaped as in *C. consobrinus* and *C. philippinensis.* The palpi are pale, the antennæ pale yellow to brownish, becoming gradually darker distally. The postmarginal is almost twice as long as the pterostigma. The legs are pale yellow to brownish, and the fore coxæ brown to black-brown.

Length, 3 to 5 millimeters.

MINDANAO, Butuan and Dapitan.

Cleistepyris minimus var. clypeatus var. nov.

Male.—Clypeus red-brown, mandible and palpus testaceous, antenna yellow, gradually becoming brown distally. Median segment without longitudinal carina, coarsely wrinkled. Abdomen dark red-brown.

Length, 3 millimeters.

PALAWAN, Puerto Princesa.

Cleistepyris minor Kieff.

Male.—This species is differentiated from the four preceding ones by the shape of the clypeus and of the mandible. Clypeus triangular, sharply keeled, pointedly projecting in front. Mandible narrow, almost lineal, scarcely broader, distally smooth, obliquely truncate, terminating in a single pointed tooth. Punctures on head close but not touching each other. Antennæ yolk-colored, becoming gradually brown distally, infrequently unicolored yellow.

Punctures on pronotum, mesonotum, and scutellum very scattered, usually wanting on anterior half of mesonotum; parapsidal furrows more or less shortened in front. Postmarginal wanting, or at least much shorter than pterostigma. Legs yolk-colored, fore and hind coxæ and hind femora except the distal end dark brown, infrequently all of the coxæ yellow. Claw with one tooth, as in the four preceding species.

Length, 3.5 to 5.5 millimeters.

LUZON, Laguna, Los Baños, Mount Maquiling, Paete: Tayabas, Mount Banahao, Malinao. MINDANAO, Butuan.

Genus CHLOREPYRIS Kieffer

a^1. Claw with one tooth; mandible with four teeth........ **C. unidens** sp. nov.
a^2. Claw bidentate; mandible with one tooth.
  b^1. Median segment somewhat elongate, with five contiguous longitudinal carinæ, only the median carina reaching posterior margin; pterostigma truncate distally.. **C. raripilus** sp. nov.
  b^2. Median segment somewhat transverse, with five contiguous, continuous longitudinal carinæ; pterostigma distally tapering. **C. raptor** sp. nov.

Chlorepyris raripilus sp. nov.

Male.—Black, smooth, shining. Head almost circular, scarcely longer than broad, with moderately coarse, not close punctures.

Clypeus keeled, pointedly projecting. Eye bare, elongate, twice as long as its distance from posterior margin of head, four times as long as cheek; posterior ocelli twice as far from posterior margin of head as from each other. Mandible red-yellow, long, narrow, obliquely truncate at end and terminating in a pointed, slightly curved tooth. Palpi pale, maxillary palpus reaching beyond middle of head, at least four-jointed. Antenna without hairs, scape black-brown, as long as fourth joint, the following joints reddish, gradually darkening to black-brown; second joint very small, scarcely as long as thick, thinner than the following ones; third longest, almost three times as long as thick; fourth like fifth, almost twice as long as thick; third to fifth weakly curved; the following ones cylindric, gradually becoming thinner; twelfth more than twice as long as thick, scarcely shorter than the last segment.

Pronotum almost transverse, posteriorly scarcely broader than anteriorly, with traces of scattered hairy punctures, almost twice as long as mesonotum, the latter smooth, without punctures. Parapsidal furrows terminating abruptly in front of anterior and posterior margins, converging and widening posteriorly. Scutellum smooth, bifurcate at base, the foveæ rather circular, separated from each other by almost twice their width, and connected by a fine furrow. Median segment scarcely longer than broad, marginate laterally and posteriorly, closely transversely striated, with five contiguous longitudinal carinæ in the middle, the median one continuous, the other four slightly converging posteriorly and not reaching posterior margin; posterior surface vertical, transversely aciculated, with a median longitudinal carina. Metapleura finely, longitudinally aciculated.

Wings almost hyaline. Pterostigma distally truncate, in the proximal half with a white dot, pale yellow like the veins; costal thick, contiguous to subcostal; basal very slanting, originating in the proximal end of pterostigma, half as long as radial; transversal almost vertical, shorter than basal. Tibiæ brown without spines; tarsi red-yellow; second to fourth joints of fore tarsus somewhat transverse and heart-shaped; claws furcate, proximal tooth shorter and much broader than distal, and obliquely truncate. Abdomen convex, smooth, conically tapering caudad.

Length, 5.5 millimeters.

MINDANAO, Butuan.

Chlorepyris raptor sp. nov.

Male.—Black, smooth, and shining. Head, mandible, and clypeus as in the preceding species but the eye (which is bare) is longer by two-thirds than the occiput. Palpi pale. Antenna red-yellow except the scape, bare, and shaped as in the preceding species. Pronotum twice as long as mesonotum; this with fine, not very close punctures; parapsidal furrows continuous, almost parallel, thin, posteriorly abruptly ovately widened. Grooves of scutellum separated from one another by more than three times their diameter but connected by a fine furrow. Median segment scarcely transverse, marginate laterally and posteriorly, transversely striated, with five contiguous, continuous, almost parallel, longitudinal carinæ; posterior surface faintly excavated, rather smooth, with a median longitudinal carina. Metapleura finely, longitudinally aciculated; mesopleura smooth.

Wings yellowish; pterostigma tapering distally, a white dot in the proximal half; basal very slanting, originating in the white dot of pterostigma, half as long as radial, longer than transversal, this less oblique, curved terminally; subcostal contiguous to costal; no postmarginal. Tibiæ brown, knees and tarsi rusty yellow; middle tibia very slightly spined; third and fourth joints of fore tarsus heart-shaped, as long as broad; claws furcate, proximal tooth pointed like the distal one and a little shorter. Abdomen convex, tapering conically behind.

Length, 5.5 millimeters.

NEGROS, Cuernos Mountains.

Chlorepyris unidens sp. nov.

Female.—Black, shining. Head almost circular, with coarse, rather close punctures, the interspaces smooth, yellow pubescent, like pronotum; frons faintly notched anteriorly; clypeus very small, scarcely visible; cheek almost wanting; eye bare, somewhat shorter than occiput; posterior ocelli separated from posterior margin of head by twice their diameter. Mandible dark brown, distally very broad, with two large lower and two smaller upper dark teeth. Palpi small. Antenna red-brown; scape black, broader than flagellum, curved, as long as the following three joints together, coarsely punctured and yellow pubescent like the head, second and third joints somewhat thinner than the following ones, scarcely as long as thick, smooth and shining; fourth to thirteenth at first as long as thick, then somewhat longer; hairs recumbent, scarcely visible.

Pronotum somewhat longer than broad, gradually broader caudad, coarsely punctured like the head. Mesonotum two-thirds as long as pronotum, anterior half smooth, posterior half rather coarsely punctured; parapsidal furrows diverging in the anterior half, parallel and scarcely broader in the posterior half. Scutellum with coarse punctures laterally, the two foveæ widely separated from each other, nearer to the lateral margin of scutellum, connected by a fine cross furrow. Median segment almost quadrate, marginate laterally and posteriorly, cross-wrinkled, with five contiguous, continuous, parallel longitudinal carinæ; posterior surface smooth, with a medial longitudinal carina. Metapleura opaque, very finely longitudinally striated, mesopleura scatteredly punctured.

Wings yellowish; subcostal contiguous to costal, pterostigma three times as long as wide, rounded distally, yellow like the veins, white at base; postmarginal wanting; basal very oblique, somewhat curved, originating in the distal end of subcostal; transversal as long and as oblique as basal, not curved, but the posterior end incurved; radial twice as long as basal. Tegula red-brown; fore tibia dark red-brown; all tarsi rusty red; femora, especially the fore, compressed and very much broadened laterally, more than twice as broad as the thickened tibiæ; middle tibia strongly spined, second to fourth joints of fore tarsus heart-shaped, nearly transverse, spined; claw with one small tooth in the middle. Abdomen convex, with hairy spots on the conical posterior half.

Length, 7 millimeters.

LUZON, Tayabas, Mount Banahao.

Genus CALYOZA Westwood

Calyoza nigra sp. nov.

Male.—Black, smooth, shining. Head with moderately close and slightly coarse punctures, as long as broad; eye bare, elongate, three times as long as cheek, twice as long as its distance from posterior margin of head; posterior ocelli scarcely farther from posterior margin of head than from each other; mandible sublinear, distal end truncate and toothed, the lower tooth moderately long, the two or three upper ones scarcely visible; maxillary palpus half as long as head, at least 4-jointed; labial palpus at least 2-jointed; clypeus not visible. Antenna 13-jointed, the first three joints black, the others black-brown; scape at least twice as long as thick, second and third joints hardly visible, forming small, shining, very transverse rings; fourth to eleventh thick, nearly transverse when viewed from above; twelfth longer than thick, thirteenth twice as long as twelfth, fourth to twelfth ventrally with a straplike, compressed, very short-pubescent branch, first and last branches not twice as long as joint, the seven remaining two to three times as long as the joint.

Pronotum somewhat longer than broad, broadening caudad, punctured like the head; mesonotum strongly transverse, scarcely longer than scutellum, both punctured like the head; parapsidal furrows strongly widened behind, lateral furrows almost continuous. Grooves of scutellum separated from each other by more than their breadth. Median segment dorsally flat, coarsely cross-grooved, laterally and posteriorly edged by a groove; this is bordered on both sides by a carina; middle part of segment with a median longitudinal carina and two lateral oblique carinæ, these converging posteriorly; posterior surface vertical, transversely striated, with a median longitudinal carina. Metapleura closely longitudinally striated; mesopleura coarsely punctured.

Wings yellow, shining; pterostigma large, golden yellow like the veins; pubescence yellow, very fine and short; radial scarcely longer than basal; subcostal near to anterior margin; basal very slanting, originating in the distal end of subcostal, much longer than transversal, this almost vertical; medial not passing beyond the basal cell. Tarsi and distal end of fore tibia rust colored, middle tibia with very small, yellow, scarcely visible spines; joints of fore tarsus elongate; claw curved, furcate, proximal tooth somewhat shorter than the distal one, base of claw with a blunt projection. Abdomen strongly convex, gradually tapering to a point.

Length, 4.5 to 8 millimeters.

PALAWAN, Puerto Princesa.

Genus APENESIA Westwood

Hitherto no species of this genus has been known from the Philippines. Professor Baker has sent me the following:

Apenesia unicolor Kieff.

Female.—Eyes only punctiform.

PALAWAN, Puerto Princesa.

This species has hitherto been known only from Fernando Po Island, West Africa.

Genus PSEUDISOBRACHIUM Kieffer

Pseudisobrachium philippinarum sp. nov.

Female.—Black, opaque, without wings. Head quadrangular, scarcely longer than broad, broader than pronotum by a half, with fine yellow hairs, dorsally and ventrally rather flat, reticulate-punctate, the posterior half dorsally with a smooth median longitudinal line; eyes and ocelli wanting; mandible yellow, two-thirds as long as head, narrow, bidentate at end, the two teeth brown and narrow. Palpi yellow, small; maxillary palpus with three prominent joints. Antenna yellow, 13-jointed; scape curved, as long as the following five joints together, third to thirteenth joints compact, twice as thick as long, only the third and the thirteenth elongate. Thorax shaped as in *P. intermedium* Kieff.[2]

Pronotum with a narrow red crossband before the posterior margin, coarsely and closely punctured like the mesonotum. Median segment shining, almost smooth, very finely coriaceous. Legs yellow, middle tibia closely spined laterally. Abdomen shining.

Length, 4 millimeters.

MINDANAO, Butuan.

This is the first species of this genus from the Indo-Malayan region.

Pseudisobrachium unidens sp. nov.

Male.—Black. Head short-elliptic, somewhat longer than broad, lustrous, closely and moderately coarsely punctured; eye hairy, separated by almost its entire length from posterior margin of head; posterior ocelli as far from each other as from posterior margin of head. Clypeus yellow in front, large, very transverse, medial projecting in front sharply triangularly, faintly keeled. Mandible yellow, rather long, narrow, distally scarcely broader, terminating in a sharp tooth. Palpi pale; maxillary palpus at least 4-jointed. Antenna almost imperceptibly pubescent, first and second joints yellow, first as long as third, second annular and very small, third scarcely longer than fourth, this fully twice as long as thick, distal joints thinner, twelfth much shorter than the last one.

Pronotum, mesonotum, and scutellum opaque and finely coriaceous; pronotum also with rather close, shallow punctures, scarcely as long as broad, broader behind than in front, somewhat longer than mesonotum; parapsidal furrows wanting; scutellum with a straight cross furrow in front; median segment distinctly longer than broad, coriaceous, shining, with one continuous median longitudinal carina, marginate laterally but not so posteriorly, posterior declivous surface without longitudinal carina. Mesopleura and metapleura finely coriaceous.

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[2] Tierreich 41 (1914) 472, fig. 176.

Wings brownish, with white, branched lines; subcostal contiguous to costal, distally less so; pterostigma narrow, with white proximal end; postmarginal half as long as radial; basal oblique, separated by its length from the white base of pterostigma; radial almost four times as long as basal; transversal sending forth a longitudinal vein behind the middle; only traces of distal and posterior veins of discoidal cell present; tegula yellow. Legs very pale yellow; femora slightly thickened. Abdomen almost flat, elongate-elliptic.

Length, 3 millimeters.

LUZON, Laguna, Mount Maquiling.

Genus **PAREPYRIS** Kieffer

No species of this genus has hitherto been known from the Philippines.

a^1. Claws straight, the two proximal teeth much broader than the distal ones, truncate at the end; wings brownish, with white lines. **P. truncatidens** sp. nov.

a^2. Claws curved, the two proximal teeth pointed, not broader than the distal ones.

- b^1. Wings hyaline, without white lines; metapleura opaque, very finely longitudinally striate.......... **P. acutidens** sp. nov.
- b^2. Wings brownish, with white branched lines; metapleura smooth and shining.......... **P. pleuralis** sp. nov.

Parepyris truncatidens sp. nov.

Male.—Black, shining. Head almost circular, scarcely longer than broad, finely and not closely punctured; forehead blunt in front; clypeus strongly keeled; eyes bare, elongate, distance between them two-thirds longer than their distance from posterior margin of head; posterior ocelli separated from posterior margin by twice their diameter; cheeks almost wanting; mandible red-brown, curved, sublineal, distally truncate, the lower edge terminating in a sharp tooth. Palpi pale; maxillary palpus almost reaching posterior margin of head, at least 4-jointed; ultimate joint of labial palpus twice as long as penultimate. Antenna brown, filiform, scape black-brown, as long as the following two joints together; second joint somewhat shorter than third, cylindric as are the following; fourth scarcely longer than third, fourth to twelfth twice as long as thick, thirteenth longer than twelfth; hairs erect, half as long as thickness of joints.

Pronotum smooth, narrower than head, at least as long as broad, broader behind than in front; mesonotum strongly transverse, smooth, much shorter than pronotum; parapsidal furrows parallel, gradually widening behind, scarcely terminating in front of the posterior margin; scutellum smooth, grooves oval, separated from each other by their diameter. Median segment scarcely transverse, marginate laterally and posteriorly, smooth, shining, with a continuous median longitudinal carina and two lateral parallel carinæ reaching only to the middle, the space between these carinæ irregularly, longitudinally rugose to the posterior margin; posterior angles truncate; posterior surface vertical, smooth, shining, with a median longitudinal carina. Metapleura opaque and finely coriaceous; mesopleura almost smooth, shining.

Wings brownish, with white, branched lines; subcostal almost touching costal; pterostigma narrow and long, proximal white, postmarginal half as long as radial, this curved, two and a half times as long as basal; transversal curved; basal very slanting, originating in the thickened distal end of subcostal; tegula red-brown. Femora black-brown; tibiæ brown, their distal end and the tarsi rusty red, second to fourth joints of fore tarsus heart-shaped, almost transverse; claw straight, pectinate, tridentate, its distal tooth curved and pointed, the two proximal ones much broader but somewhat shorter than the distal, broadly truncate at end. Abdomen slightly convex, smooth, somewhat tapering behind.

Length, 3.8 millimeters.

MINDANAO, Butuan. NEGROS, Cuernos Mountains.

Parepyris acutidens sp. nov.

Male.—Black. Mandible and tegula red-brown; palpi pale, scape and the next following joints testaceous, the other joints gradually becoming dark brown; femora black-brown, tibiæ light brown, tarsi rusty yellow. Differentiated from the preceding species by the following characters: Hairs of antenna scarcely visible, not one-third as long as the thickness of joints; pronotum somewhat transverse, much longer than mesonotum; parapsidal furrows distinctly diverging anteriorly. Median segment finely wrinkled, between the three longitudinal carinæ with coarser and almost reticulate wrinkles; metapleura opaque, very finely striate longitudinally. Wings hyaline, without white lines; postmarginal distinctly reaching beyond the middle of radial. Claws curved, the three teeth pointed, equally broad

Length, 5.6 millimeters.

MINDANAO, Butuan.

Parepyris pleuralis sp. nov.

Male.—Black. Mandible and tegula red-brown; palpi pale, scape black-brown proximally, testaceous distally, the three or four following joints testaceous, the following ones gradually growing darker to black-brown; femora black-brown, tibiæ brown, tarsi rusty yellow. Differentiated from *P. acutidens* by the following characters: Hairs of antenna one-third as long as thickness of joints; parapsidal furrows scarcely diverging; metapleura smooth and shining; wings brownish, with white, branched lines, simulating the obsolete veins. Teeth of claw pointed and shaped as in the preceding species.

Length, 4 millimeters.

LEYTE, Tacloban.

Genus **MELANEPYRIS** Kieffer

Only an African species has been known hitherto in this genus.

Melanepyris asiaticus sp. nov.

Male.—Black, shining. Head and thorax finely hairy; head distinctly longer than broad, with fine, scattered punctures; eye bare, elongate, almost as long as its distance from posterior margin of head; forehead truncate in front; cheek almost wanting; clypeus strongly keeled. Mandible red-brown, sublineal, distally truncate, lower edge terminating in a sharp tooth, the two upper teeth very small. Antenna dark brown, filiform, distally thinner, distal end of first two joints light brown; scape little shorter than the following two joints together; second joint almost twice as long as thick, shorter than third; fourth scarcely longer than third, more than twice as long as thick; twelfth more than three times as long as thick, scarcely shorter than thirteenth; hairs half as long as thickness of joints. Palpi pale; maxillary palpus reaching beyond middle of head, at least 4-jointed, labial palpus at least 2-jointed.

Pronotum trapezoid, as long as broad, punctured like the head, at least a third longer than mesonotum; this smooth in the anterior half, in the posterior half finely coriaceous and punctured like the pronotum; parapsidal furrows parallel, fine, ovately widened at posterior end. Scutellum opaque, coriaceous, finely punctured, grooves elliptic, separated from each other by a carina. Median segment somewhat elongate, marginate laterally, not so posteriorly, finely coriaceous or finely transversely striate, with a continuous medial longitudinal carina; posterior surface smooth, somewhat depressed, with a median carina; metapleura opaque, finely rugose longitudinally; tegula red-brown.

Wing lightly brownish; subcostal adjacent to costal; pterostigma narrow, long, the second quarter white; radial curved, two and one-half times as long as basal; postmarginal a third as long as radial; basal very oblique, originating in the proximal end of pterostigma, somewhat more oblique than the curved transversal. Legs light brown, coxæ black, femora thick, tibiæ without spines, claws simple. Abdomen rather flat, smooth, long-elliptic.

Length, 4.8 millimeters.

MINDANAO, Dapitan.

Genus HOLEPYRIS Kieffer

a^1. Pronotum with a fine median longitudinal furrow in the posterior half, with reticulate punctation like that on head; posterior surface of median segment with three longitudinal carinæ.... **H. dubiosus sp. nov.**

a^2. Pronotum without longitudinal furrow, smooth, almost without punctation as the head... **H. philippinensis sp. nov.**

Holepyris philippinensis sp. nov.

Male.—Black. Head almost quadrate, smooth, shining, with few, scattered, small punctures; eye subglabrous, very short and very sparsely hairy, much longer than occiput; posterior ocelli separated from posterior margin of head by their diameter; clypeus very transverse, trilobed, the median lobe triangular and strongly keeled; mandibles red; palpi pale, maxillary palpus 5-jointed. Antenna dark red-brown, distal end of scape and second joint lighter, scape distinctly shorter than second and third joints together, second joint twice as long as thick, third scarcely longer than second, fourth somewhat shorter than third, the next following ones like the fourth, distal joints gradually shorter, twelfth scarcely twice as long as thick, shorter than thirteenth, the hairs not half as long as the thickness of joints.

Pronotum smooth and shining, like the mesonotum and scutellum, trapezoid and transverse, anteriorly with an impressed crossline; mesonotum somewhat shorter than pronotum; cross furrow of scutellum broad; median segment at least as long as broad, laterally and indistinctly posteriorly marginate, finely wrinkled, with five longitudinal carinæ in the middle, the medial carina continuous, the other four not so, posterior surface vertical, finely wrinkled, with three longitudinal wrinkles in the middle. Metapleura shining, very finely coriaceous, mesopleura coarsely so.

Wings brownish, with white branched lines; pterostigma narrow, brown like the veins, proximal third white; postmarginal wanting; basal very oblique, arising a little before the distal end of subcostal; radial more than three times as long as basal; transversal as long and as oblique as basal. Femora black-brown, trochanters, tibiæ, and tarsi testaceous, tibiæ without spines, claws furcate, both teeth pointed and of equal length, at base a blunt projection. Abdomen slightly convex, long-elliptic.

Length, 3.2 millimeters.

MINDANAO, Butuan.

Holepyris philippinensis var. **fuscicornis** var. nov.

Male.—Like the preceding, with the following exceptions: Antenna black-brown, first and second joints testaceous; head very finely coriaceous, with scattered fine punctures; eye not so long, only one-third longer than occiput. Median segment with three longitudinal carinæ; posterior surface with a median carina.

Length, 3.5 millimeters.

MINDANAO, Butuan.

Holepyris philippinensis var. **rugosus** var. nov.

Male.—Like the type, with the following exceptions: Mandible long, thin, pointed, and much curved. Posterior surface of median segment without carina, with coarse, almost reticulate wrinkles like the mesopleura and the metapleura. Legs brownish yellow, coxæ black, fore and hind femora brown in the middle.

Length, 3.5 millimeters.

LUZON, Mount Maquiling.

Holepyris dubiosus sp. nov.

Female.—Black, only the trochanters and tarsi dark red-brown. Head opaque, somewhat longer than broad, behind the eyes rather narrowed, reticulate-punctate. Eye shortly hairy, at least twice as long as occiput. Posterior ocelli nearer to posterior margin of head than to each other; cheek almost wanting; maxillary palpus at least 4-jointed; scape somewhat longer than second and third joints together; joints two to twelve cylindrical, the second one-half longer than thick, third twice as long as thick, the following ones slightly shorter than third, all elongate, thirteenth long and tapering to a point.

Pronotum opaque, reticulate-punctate, distinctly longer than broad, somewhat broader behind than in front, much narrower than head, the posterior half with a fine median furrow, a cross-row of small depressions in front of posterior margin. Mesonotum transverse-elliptic, half as long as pronotum, lustrous and rather smooth, anteriorly with a smooth, depressed, curved crossline, posteriorly with a curved, coarse, crenulated cross furrow; scutellum with a broad cross furrow. Median segment as broad as long, laterally and posteriorly marginate, cross-wrinkled, with five parallel, continuous longitudinal carinæ in the middle, posterior angles truncate and with two small teeth; posterior surface vertical, coarsely rugose, with three continuous, contiguous longitudinal carinæ. Metapleura closely and coarsely longitudinally striated, the striæ sometimes curved and concentric; mesopleura opaque, coarsely rugose; propleura opaque and coriaceous.

Wings brownish, with white, branched lines; pterostigma narrow, brown like the veins, proximal third white; subcostal near to costal; postmarginal wanting; basal much oblique, arising in the distal end of subcostal; radial two and a half times as long as basal; transversal as oblique as basal. Legs almost bare; femora moderately thick; third and fourth joints of fore tarsus deep heart-shaped. Abdomen convex, smooth, consisting of seven or eight segments tapering to a point behind and with a projecting ovipositor.

Length, 4.5 millimeters.

PALAWAN, Puerto Princesa.

Genus **XENEPYRIS** Kieffer

Xenepyris exaratus sp. nov.

Male.—Like *X. compressicornis* but distinguishable from it by the following characters: Black; mandible red-brown; palpus and antenna yellow; scape brown; legs brownish yellow, fore coxæ darker; eye twice as long as occiput; antenna not distinctly compressed, joints three to eleven fully twice as long as thick, twelfth longer than the one preceding; parapsidal furrows dorsally scarcely widened and strongly converging; grooves of scutellum scarcely separated from each other by their breadth; median segment with three longitudinal carinæ, the middle one continuous, the other two scarcely extending beyond the middle; dorsal vertical surface transversely striate; metapleura coarsely longitudinally striated; basal almost twice as long as transversal.

Length, 4 millimeters.

LUZON, Laguna, Mount Maquiling.

Genus RHABDEPYRIS Kieffer

a^1. Postmarginal wanting; eye one-third longer than occiput. **R. defectus** sp. nov.

a^2. Postmarginal longer than basal; eye more than twice as long as occiput. **R. luzonicus** Kieff.

Rhabdepyris defectus sp. nov.

Female.—Black. Head almost circular, opaque, with almost thimblelike punctation and, like the dorsum of thorax, finely yellow pubescent. Eye a third longer than occiput with close yellow hairs; posterior ocelli scarcely farther from posterior margin of head than each other. Clypeus triangular, strongly keeled. Mandible red-brown, sublinear, quadridentate, the two upper teeth very small, the two longer ones moderately long. Palpi pale. Antenna dark red-brown, ventrally lighter red; greater part of scape black-brown, as long as the following three joints combined, second joint turbinate, somewhat elongate, scarcely longer and thinner than third, this as long as thick, joints four to twelve transverse, thirteenth elongate and pointed, all glabrous.

Pronotum scarcely elongate, opaque, very finely coriaceous and with close, moderately coarse, very shallow punctures, somewhat broader behind than in front, mesonotum two-thirds as long as pronotum, shining, anterior half unpunctured, posterior half closely and finely punctured; parapsidal furrows parallel, the lateral furrows almost continuous; scutellum sculptured like pronotum, cross furrow broad. Median segment as long as broad, wrinkled crosswise, with five contiguous, parallel, and continuous longitudinal carinæ in the middle, laterally and posteriorly marginate; posterior angles truncate, with two indistinct teeth; posterior declivous surface somewhat excavated, almost smooth, the edges coarsely wrinkled, with one broad median carina. Metapleura obliquely striate; mesopleura coarsely coriaceous.

Wings slightly yellowish; pterostigma and veins yellow; marginal wanting; basal oblique, arising in the distal end of subcostal; transversal less oblique; radial three times as long as basal; white lines branched. Femora dark brown, the four fore tibiæ red-brown like the tarsi; tibiæ without spines; third and fourth joints of fore tarsus heart-shaped. Abdomen convex, tapering to a point behind.

Length, 5 millimeters.

LUZON, Laguna, Mount Maquiling.

Rhabdepyris luzonicus Kieff.

Male.—Posterior ocelli separated from each other and from the posterior margin of head by their diameter. Flagellum very short pubescent. Posterior surface of median segment as in the preceding species. Metapleura coarsely wrinkled.

LUZON, Laguna, Mount Maquiling.

Genus **EPYRIS** Westwood

In addition to the two species already known from the Philippines, there are sixteen new species.

a^1. Median segment with one longitudinal carina in the middle; grooves of scutellum separated from one another by at least their width.

b^1. Postmarginal wanting........ **E. parvidens** sp. nov.

b^2. Postmarginal well developed........ **E. unicarina** sp. nov.

a^2. Median segment with three longitudinal carinæ in the middle.

c^1. Pronotum with an impressed crossline in front and behind. **E. quaesitor** sp. nov.

c^2. Pronotum without impressed crossline.

d^1. Eye glabrous; third antennal joint of male longer than fourth, second thinner than third.

e^1. Metapleura coarsely longitudinally striate; pterostigma and radial black-brown........ **E. psilomma** sp. nov.

e^2. Metapleura finely coriaceous; pterostigma and all veins golden yellow........ **E. quadratus** sp. nov.

d^2. Eye hairy.

f^1. Grooves of scutellum separated from one another by at least their breadth.

g^1. Costal wanting; grooves of scutellum separated by twice their breadth........ **E. apertus** Kieff.

g^2. Costal present.

h^1. Head almost twice as long as broad; eye shorter than occiput; veins and pterostigma yellow.... **E. magniceps** sp. nov.

h^2. Head almost circular; eye at least as long as occiput.

i^1. Eye more than twice as long as occiput; grooves of scutellum separated by their diameter; veins and pterostigma yellow........ **E. pusillus** sp. nov.

i^2. Eye as long as occiput or scarcely longer, grooves of scutellum separated by three times their diameter; pterostigma black-brown, veins pale.... **E. distans** sp. nov.

f^2. Grooves of scutellum in contact or separated only by a carina.

j^1. Transversal branching off before the middle in a short branch........ **E. subramosus** sp. nov.

j^2. Transversal without branch.

k^1. Eye distinctly longer than occiput (that is, than distance of eye from posterior margin of head).

l^1. Postmarginal well developed; wing hyaline.
  m^1. Legs yellow, middle of femora brown; pterostigma and veins brown; pronotum and mesonotum opaque, finely coriaceous, unpunctured. **E. claripennis sp. nov.**
  m^2. Legs black, tibiæ and tarsi red; pterostigma and veins yellow; pronotum coriaceous and closely punctured; mesonotum smooth and shining. **E. despectus sp. nov.**
l^2. Postmarginal wanting.
  n^1. Legs unicolored red-yellow; eye two-thirds longer than occiput; median segment at least as long as broad; pronotum and mesonotum smooth and shining.. **E. rejectus sp. nov.**
  n^2. Legs partly black; eye not so long; median segment somewhat transverse.
    o^1. Mesonotum smooth and shining in the anterior half, in the posterior coarsely and closely punctured like the pronotum; coxæ and femora black.
      p^1. Mandible bidentate; wing hyaline; antenna red-brown.. **E. bidens sp. nov.**
      p^2. Mandibles with three teeth........ **E. tridens sp. nov.**
    o^2. Mesonotum uniformly sculptured.
      q^1. Pronotum, mesonotum, and scutellum shallowly and not very coarsely punctured; grooves of scutellum separated by a carina. **E. philippinensis Kieff.**
      q^2. Pronotum and mesonotum opaque, finely coriaceous, unpunctured; scutellum smooth and shining................................ **E. troglodytes sp. nov.**
k^2. Eye only as long as occiput; head coarsely and closely punctured; median segment at least as long as broad; postmarginal wanting............................ **E. obliquus sp. nov.**

Epyris distans sp. nov.

Female.—Black. Head rather quadrate, scarcely elongate, almost smooth, with very fine, hairy, scattered punctures, and very finely coriaceous. Eye hairy, not or scarcely longer than occiput; posterior ocelli touching posterior margin of head; clypeus triangular, strongly keeled; mandibles yellow-red, lineal, narrow, curved, obliquely truncate at the end. Palpi pale; maxillary palpus at least 4-jointed. Antenna yellow-red, glabrous; scape dark in the middle, as long as the following three joints together, second and third joints transverse, fourth ás long as thick, the last three or four somewhat elongate, thirteenth longer and thinner.

Pronotum sculptured like the head, as long as broad, widened dorsally, almost twice as long as mesonotum, this smooth like scutellum; parapsidal furrows parallel, dorsally scarcely broader, lateral furrows short; grooves of scutellum small, separated by three times their breadth. Median segment as long as broad, laterally and dorsally marginate, cross-wrinkled, with three parallel longitudinal carinæ in the middle, the medial carina continuous, the other two reaching only to the middle; posterior surface vertical, almost smooth, with one longitudinal carina. Metapleura very finely longitudinally striate.

Wings faintly fuliginous; pterostigma brown, proximal third white, veins pale; postmarginal wanting; basal very oblique, arising in distal end of subcostal; radial two and a half times as long as basal; transversal as oblique and as long as basal, angularly curved at posterior third. Tegulæ, trochanters, knees, tibiæ, and tarsi yellow-red, femora brown, middle tibia short and weakly spined; joints 2 to 4 of fore tarsus heart-shaped; claw with a very small, almost invisible tooth. Abdomen convex, gradually coming to a point behind, smooth.

Length, 4 millimeters.

LUZON, Tayabas, Mount Banahao.

Epyris obliquus sp. nov.

Female.—Black, shining. Head somewhat elongate, rather closely and coarsely punctured. Forehead in front bilobed; eye elongate, hairy, as long as its distance from posterior margin of head; posterior ocelli separated from posterior margin of head by their diameter; cheek very short. Mandible, palpi, and antenna yellow-red; scape as long as the following three joints united, second and third joints scarcely as long as thick, the following ones oblique, twelfth as long as thick, thirteenth elongate.

Pronotum gradually widened behind, elongate, more finely punctured than head, twice as long as mesonotum; parapsidal furrows much widened behind, shortened in front; mesonotum and scutellum punctured like pronotum; grooves of scutellum oblique, much longer than broad, almost coming together in front. Median segment at least as long as broad, quadrate, finely, transversely striate, with three continuous longitudinal carinæ, the lateral carina equidistant from the median carina and from the marginal carina, all three parallel, the posterior margin bordered by a transverse carina; dorsal surface vertical, transversely striate and with a medial longitudinal carina.

Wings fuliginous; subcostal contiguous to front margin; pterostigma elliptic, with a white dot at base, the distal brown portion not twice as long as broad; basal as oblique and as long as transversal, arising in the distal end of subcostal, radical slightly curved, almost three times as long as basal; postmarginal wanting. Legs yellow-red, coxæ black, middle of femora blackbrown, middle femur unicolored yellow-red; joints 2 to 4 of fore tarsus not longer than broad. Abdomen convex, tapering behind, dorsal third as well as the head more strongly pubescent than the rest of the body.

Length, 3 millimeters.

MINDANAO, Butuan.

Epyris bidens sp. nov.

Male.—Black, shining. Head subcylindrical, rather closely and moderately coarsely punctured; eye hairy, longer by one-third than its distance from posterior margin of head; posterior ocelli separated from posterior margin of head by twice their diameter; cheek very short. Mandible red-brown, thin, with two teeth at end, the lower tooth long and pointed, the upper one very small. Antenna without hair, filiform, red-brown, scape as long as the following two joints together, second joint somewhat tranverse, third scarcely as long as thick, fourth to twelfth somewhat longer than third, thirteenth twice as long as thick.

Pronotum somewhat elongate, moderately coarsely punctured, a little wider dorsad; mesonotum oblique, a little shorter than pronotum, parapsidal furrows parallel, much widened dorsally, anterior half of mesonotum smooth, posterior half closely punctured. Scutellum smooth, grooves oval, somewhat obliquely in contact in front. Median segment somewhat transverse, finely, transversely striate, with three continuous longitudinal carinæ in the middle, the two outer ones in front as far from the medial as from the marginal carinæ, strongly convergent posteriorly, posterior margin of median segment bordered by a cross carina; posterior surface same as in the preceding species.

Wings brownish, venation and pterostigma as in the preceding species; postmarginal wanting; transversal less oblique than basal. Tibiæ and tarsi red-brown, claws with a small tooth in the middle. Abdomen convex, conically tapering behind, unpunctured.

Length, 3 millimeters.

MINDANAO, Iligan.

Epyris tridens sp. nov.

Male.—Same as *E. bidens* except that the mandible has three teeth, the lower tooth long. Maxilliary palpus 5-jointed, labial palpus 3-jointed. Parapsidal furrows wanting in front, slightly wide behind. Wings hyaline; postmarginal wanting in this species also.

Length, 3 millimeters.

LUZON, Laguna, Los Baños.

Epyris despectus sp. nov.

Male.—Black. Head subcylindrical, lustrous, finely coriaceous, closely and moderately coarsely punctured; eye hairy, almost twice as long as occiput, posterior ocelli separated from posterior margin of head by their diameter; clypeus triangular, strongly keeled; mandible yellow-red; palpi pale. Antenna scarcely perceptibly hairy, filiform, gradually narrowing distally, yellow-red except scape, second joint distinctly shorter and thinner than third, third to twelfth somewhat longer than thick, thirteenth longer.

Pronotum transverse, trapezoid, sculptured the same as the head but punctation shallower; mesonotum somewhat shorter than pronotum, smooth, shining, with a few indistinct, scattered, fine punctures, parapsidal furrows parallel, not widened behind; scutellum smooth, shining, grooves transversely oval, in contact. Median segment scarcely as long as broad, cross-wrinkled, laterally and posteriorly marginate, with three continuous longitudinal carinæ converging posteriorly.

Wings subhyaline; pterostigma lineal, yellow like the veins; postmarginal nearly half as long as radial; basal very oblique, arising in the distal end of subcostal, one-third as long as radial; transversal almost vertical, slightly curved. Tegulæ, tibiæ, and tarsi yellow-red, tibiæ unspined. Abdomen convex, gradually narrowing behind.

Length, 3.5 millimeters.

LUZON, Laguna, Mount Maquiling.

Epyris troglodytes sp. nov.

Male.—Like *E. bidens* with the following exceptions: Mandible red-brown, distally broader, obliquely truncate, with four teeth, the lower one long, the other three very small. Head finely coriaceous between punctures; posterior ocelli distant from posterior margin of head by more than twice their diameter; antenna black-brown. Pronotum, mesonotum, and scutellum finely coriaceous, opaque, with no punctures or a few, scattered, shallow ones; parapsidal furrows much widened and converging posteriorly. Grooves of scutellum elliptic, transverse, almost in contact. The two outer carinæ of median segment scarcely converging posteriorly; postmarginal wanting as in the preceding species. Abdomen rather flat, long-elliptic.

Length, 3 millimeters.

LUZON, Laguna, Los Baños, 4 specimens.

Epyris claripennis sp. nov.

Male.—Like *E. troglodytes*, except that the parapsidal furrows are not distinctly widened posteriorly; wings hyaline; postmarginal half as long as radial; legs including coxæ yellow-red, only the thickened portion of femur brown.

Length, 3.5 millimeters.

LUZON, Laguna, Los Baños.

Epyris rejectus sp. nov.

Female.—Black, smooth, and shining. Head subcylindrical; eyes finely hairy, two-thirds longer than occiput; cheek very short. Palpus, mandible, and antenna testaceous, the latter becoming gradually darker distally, second and third joints thin, as long as thick, the following ones thicker and very transverse, thirteenth oblong. Pronotum a half longer than mesonotum, behind slightly broader than in front; parapsidal furrows continuous, nearly parallel, not broadened behind. Grooves of scutellum transverse and in contact. Median segment fully as long as broad, laterally and posteriorly marginate, finely cross-aciculate, in the middle with three contiguous longitudinal carinæ scarcely converging behind, the medial one continuous, the other two almost continuous; posterior surface vertical, finely, transversely aciculate, with a median carina. Metapleura finely, longitudinally striated.

Wings subhyaline; pterostigma long and narrow, basal very oblique, as much so and as long as transversal, one-third as long as radial, proximal arising in the white dot on pterostigma; postmarginal wanting; subcostal near to anterior margin. Legs testaceous, fore and hind femora brownish, tibiæ without spines. Abdomen convex, conically tapering behind.

Length, 2 millimeters.

LUZON, Laguna, Mount Maquiling.

Epyris pusillus sp. nov.

Female.—Black. Head subcylindrical, lustrous, with shallow, rather close punctures; eye finely hairy, elongate, more than twice as long as its distance from posterior margin of head; cheek very short; mandible testaceous; posterior ocelli distant from posterior margin of head by their diameter. Forehead notched in front, bilobed. Clypeus deep, strongly keeled. Maxillary palpus pale, at least 4-jointed. Distal end of scape and the following two joints testaceous.

Pronotum, mesonotum, and scutellum almost opaque, unpunctured; pronotum one and a half times as long as mesonotum, somewhat transverse, slightly broader behind than in front. Parapsidal furrows almost parallel, widened behind, lateral furrows not continuous. Grooves of scutellum ovate, somewhat oblique, separated from each other by scarcely their diameter. Median segment slightly transverse, laterally and posteriorly marginate, opaque, finely cross-wrinkled, with three longitudinal carinæ in the middle, the outer ones of which scarcely converge behind and end shortly before the posterior margin; posterior surface vertical, finely cross-aciculate, with a median carina. Metapleura finely coriaceous, opaque; mesopleura more coarsely coriaceous.

Wings rather hyaline; pterostigma without white spot, truncate distally, pale yellow like the veins; subcostal near to anterior margin; basal very oblique, a third as long as radial, arising in the proximal end of pterostigma; transversal shorter, almost vertical; postmarginal wanting. Tibiæ and tarsi testaceous, the tibiæ without spines, claw with one tooth in the middle. Abdomen convex, tapering to a point behind.

Length, 3.5 millimeters.

MINDANAO, Butuan.

Epyris quaesitor sp. nov.

Male.—Black. Head almost quadrate, scarcely longer than broad, lustrous, shallowly and rather coarsely punctured, between punctures very finely coriaceous; eye elongate, weakly fine-haired, scarcely longer than its distance from posterior margin of head; cheek almost wanting. Forehead unnotched in front and not bilobed. Clypeus keeled; maxillary palpus pale, reaching beyond the middle of head, at least 4-jointed. Distal end of first three antennal joints red-brown, scape as long as second and third joints united, these not so long as thick, cylindrical like the following ones, which are almost twice as long as thick, all with erect hairs that are as long as half the thickness of the joints.

Pronotum sculptured like head, somewhat transverse, equally broad in front and behind, with an impressed, crenulate line running along the anterior and posterior margins. Mesonotum somewhat shorter than pronotum; parapsidal furrows almost parallel, continuous, somewhat widened behind, lateral furrows not continuous. Grooves of scutellum ovate, almost in contact. Median segment transverse, laterally and posteriorly marginate, traversed in the middle by three parallel longitudinal carinæ, the outer ones of which scarcely reach beyond the middle; posterior surface vertical, very finely transversely striate, with a medial carina. Metapleura opaque, finely coriaceous.

Wings subhyaline; pterostigma pointed distally, with a white dot in the proximal half; subcostal near to anterior margin; basal very oblique, arising in the proximal end of pterostigma; transversal as oblique as basal, incurved at end; radial two and a half times as long as basal. Tegulæ, knees, tibiæ, and tarsi testaceous, tibiæ without spines; joints of fore tarsus not heart-shaped, somewhat longer than thick. Abdomen convex, smooth, shining, tapering conically behind.

Length, 4 millimeters.

LUZON, Laguna, Paete.

Epyris psilomma sp. nov.

Male.—Black. Head rather cylindrical, smooth, shining, with fine, not very close punctures; eye bare, elongate, more than twice as long as occiput (that is, as its distance from posterior margin of head); posterior ocelli as far from each other as from posterior margin of head; cheek almost wanting; clypeus very small. Mandible yellow-red, narrow, distally with three or four black teeth, the lower tooth long, the two or three upper teeth small; palpi pale. Antenna yellow-red, except the proximal two joints; scape as long as third joint; second very small, thinner than the following ones; third scarcely longer than fourth, almost twice as long as thick; fifth to twelfth like the fourth; thirteenth longer; all without distinct pubescence.

Pronotum transverse, broader behind than in front, unpunctured and scatteredly hairy like the mesonotum and the scutellum, longer by a half than mesonotum. Parapsidal furrows converging and much widened behind, separated from each other at the posterior end by only their breadth, anteriorly fine and not reaching anterior margin; lateral furrows not continuous. Grooves of scutellum circular, separated from each other by their diameter. Median segment as long as broad, bordered laterally by a broad groove and posteriorly by a carina, cross-wrinkled, with three longitudinal carinæ in the middle, the medial one continuous, the other two converging posteriorly and nearly continuous; posterior surface vertical, finely transversely striate, with a medial carina. Metapleura coarsely, longitudinally striated; mesopleura with two or three coarse longitudinal carinæ.

Wings faintly yellowish; pterostigma broad, not three times as long as broad, elliptic, black-brown, with white proximal end; postmarginal wanting; radial only a half longer than basal, black-brown, the other veins golden yellow; subcostal contiguous to costal; basal very oblique, arising in the distal end of subcostal, almost twice as long as the sloping transversal. Tegulæ yellow-red; tarsi and distal end of tibiæ rusty yellow, tibiæ unspined; joints 2 to 4 of fore tarsus heart-shaped, claws with a rather large tooth. Abdomen convex, gradually narrowing behind, posterior end truncate, posterior half with close, long, black hairs.

Length, 6.5 millimeters.

PALAWAN, Puerto Princesa.

Epyris quadratus sp. nov.

Male.—Black, smooth, shining. Head nearly elliptic, somewhat longer than broad, much broader than pronotum, with indications of scattered shallow punctures. Eye bare, longer than broad, at least twice as long as its distance from posterior margin of head; posterior ocelli separated from each other by their diameter, more than twice as far from posterior margin of head as from each other; cheek almost wanting. Antenna yellow-red, scape black, second joint very small and thinner than those following, third almost three times as long as thick, the following ones almost twice, the last three thinner, darker, more than twice as long as thick; without distinct pubescence.

Pronotum scarcely transverse, posteriorly a little broader, a half longer than mesonotum; parapsidal furrows continuous, posteriorly much widened and strongly convergent, lateral furrows not continuous. Grooves of scutellum ovate, separated from each other by twice their breadth. Median segment subquadrate, scarcely transverse, finely cross-wrinkled, laterally and posteriorly marginate, traversed in the middle by three longitudinal carinæ, the middle one of which is continuous, the other two nearly so and slightly converging behind; posterior surface almost vertical, rather smooth, with a medial carina. Metapleura opaque, finely coriaceous.

Wing yellowish, pterostigma long-elliptic with white proximal end, yellow like the veins; subcostal contiguous to costal; basal very oblique, arising in the thickened distal end of subcostal;

transversal shorter and nearly vertical; postmarginal almost wanting, shorter than the breadth of pterostigma; radial curved, only one and a half times as long as basal. Tegulæ and tarsi testaceous. Abdomen convex, tapering conically behind.

Length, 4.8 millimeters.

MINDANAO, Butuan.

Epyris magniceps sp. nov.

Female.—Black, smooth, shining. Head almost twice as long as broad, quadrangular, with coarse and rather close punctures, very finely coriaceous between punctures. Eye hairy, elongate, only two-thirds as long as occiput; posterior ocelli three times as far from posterior margin of head as from each other; mandible red-brown, narrow, with two black teeth; clypeus strongly keeled, sharply triangular. Palpi pale, maxillary palpus reaching beyond the middle of head, at least 4-jointed, the last three joints long, the first one very short. Antenna yellow-red, scape black-brown proximally, not so long as second and third joints united, second joint obconical, smaller and much thinner than the following ones, these cylindrical, third and fourth almost transverse, the following ones as long as or somewhat longer than thick.

Pronotum elongate, broader behind, almost twice as long as mesonotum, punctured like the head; mesonotum smooth in the anterior two-thirds, coarsely punctured in the posterior third; parapsidal furrows almost parallel, much widened behind. Scutellum very finely coriaceous, punctured only behind the grooves, with a crossrow of punctures in front of posterior margin; grooves oval, oblique, separated from each other by twice their diameter. Median segment longer than broad, marginate laterally and posteriorly, cross-wrinkled, with three contiguous, parallel, longitudinal carinæ, the middle one continuous, the other two nearly so; posterior surface very finely, transversely aciculate, with a median carina. Metapleura finely, longitudinally aciculate, mesopleura coarsely punctured. Tegula yellow-red.

Wing yellowish; pterostigma yellow like the veins, lanceolate, narrow; postmarginal wanting; basal very oblique, arising in the distal end of subcostal, transversal as oblique and as long as basal; radial almost four times as long as basal. Middle tibia, distal ends of the remaining tibiæ, and tarsi yellow-red, middle tibia unspined. Joints 2 to 4 of fore tarsus heart-shaped, claw with one very small tooth. Abdomen convex, tapering conically behind, and with a style.

Length, 7 millimeters.

PALAWAN, Puerto Princesa.

Epyris unicarina sp. nov.

Male.—Black, smooth, shining. Head nearly circular, with small, scattered punctures. Eye sparsely hairy, almost twice as long as occiput; posterior ocelli as far from each other as from posterior margin of head; clypeus triangular, strongly keeled; mandible yellow-red, almost lineal, bilobed at end, forming two teeth, between which are two very small teeth; palpi pale. Antenna with short hairs, filiform, scape and ventral side of the following two joints red-yellow, scape bare, as long as second and third joints united, segments 2 to 12 cylindrical, second and third not so thin as those following, second a little shorter than third, a half longer than thick, fourth distinctly longer than third, fully twice as long as thick, the following ones like the fourth, thirteenth somewhat longer and thinner.

Pronotum scarcely as long as broad, broader behind than in front, unpunctured. Mesonotum strongly transverse, somewhat shorter than pronotum, with few punctures; parapsidal furrows widened behind and converging, terminating before the posterior margin. Scutellum unpunctured, the grooves oval, separated from each other by their breadth. Median segment somewhat transverse, marginate laterally and posteriorly, rugose, with only one longitudinal carina in the middle; posterior surface vertical, cross-striated, with a median carina. Mesopleura smooth and shining.

Wing subhyaline, with white lines; pterostigma narrow, proximally with a white dot; postmarginal two-thirds as long as radial; basal oblique, arising in the distal end of subcostal; transversal less oblique, curved; radial two and a half times as long as basal; tegula yellow-red. Legs red-brown, coxæ black, femora brown, tibiæ unspined, third and fourth joints of fore tarsus as broad as long. Abdomen flat, elliptic.

Length, 3 millimeters.

MINDANAO, Butuan.

Epyris parvidens sp. nov.

Female.—Black, smooth, shining. Head distinctly longer than broad, with several scattered, very fine punctures; eye scarcely hairy, flat, one-third longer than occiput; posterior ocelli almost touching posterior margin of head; clypeus triangular, strongly keeled; mandible red, almost lineal, truncate at end, terminating below in a sharp tooth; palpi pale, maxillary palpus at least 4-jointed. Antenna red, scape as long as the following three joints united, second joint somewhat longer than thick, third smallest, fourth to twelfth at least as long as thick, thirteenth elongate and thinner; all bare.

Pronotum distinctly elongate, broader behind than in front, twice as long as mesonotum, both unpunctured; parapsidal furrows strongly converging behind and abruptly much widened; grooves of scutellum ovate, separated from each other by twice their breadth; median segment as long as broad, marginate laterally and posteriorly, very finely transversely striate, in places obliquely striate, with a single longitudinal carina in the middle; posterior surface vertical, nearly smooth, with a medial carina. Mesopleura smooth and shining; metapleura nearly smooth.

Wings faintly brownish; pterostigma narrow, pale like the veins, proximal third white; postmarginal wanting; basal oblique, arising in the distal end of subcostal, transversal as long and as oblique as basal; radial four times as long as basal. Tegulæ and legs red, coxæ black, femora brown, fore femur black-brown, tibiæ unspined, claw with a very small, scarcely visible tooth. Abdomen convex, sharply pointed behind.

Length, 3 millimeters.

LUZON, Laguna, Mount Maquiling.

Epyris subramosus sp. nov.

Male.—Black. Head rather cylindrical, opaque, very finely coriaceous, with rather coarse and rather close punctures; eye faintly hairy, nearly twice as long as occiput; posterior ocelli separated from posterior margin of head by more than their diameter; mandible red-brown, narrow, bidentate or tridentate at end; clypeus small; palpi brown. Antenna filiform, dorsally black-brown, ventrally red-brown, scape almost as long as second and third joints united, second joint not longer than thick, third longer and thicker than second, scarcely shorter than fourth, fourth to twelfth almost twice as long as thick, thirteenth longer; without visible pubescence.

Pronotum trapezoid, somewhat transverse, sculptured like the head, little longer than mesonotum; this smooth and shining in the anterior half, finely punctured in the posterior half; parapsidal furrows converging behind and widened. Scutellum with several scattered punctures, grooves elliptic, transverse, separated only by a carina. Median segment somewhat transverse, marginate laterally and posteriorly, cross-wrinkled, with three continuous longitudinal carinæ that converge behind; posterior surface vertical, cross-striated, with a median carina. Metapleura finely coriaceous, mesopleura closely and finely punctured.

Wings brownish, with branched white lines; pterostigma brown like the veins, proximal third white; postmarginal wanting; basal very oblique, arising in the distal end of subcostal; radial three times as long as basal; transversal oblique, curved, branching off before the middle in a very short branch. Tegulæ, tibiæ, and tarsi red-brown, middle of tibiæ brown; tibiæ unspined; joints 2 to 4 of fore tarsus heart-shaped; claw with a very small tooth. Abdomen convex, gradually narrowing behind, the pincer segments with a tuft of hair on the end.

Length, 4 millimeters.

PALAWAN, Puerto Princesa.

Genus GONIOZUS Förster

- *a^1*. Head elongate.. **G. philippinensis** Ashm.
- *a^2*. Head not longer than broad.
  - *b^1*. Median segment rather flat, without elevation in the middle.
    - *c^1*. Anterior section of basal as long as posterior.... **G. depressus** Kieff.
    - *c^2*. Anterior section of basal much shorter than posterior. **G. manilensis** sp. nov.
  - *b^2*. Median segment with a triangular elevation in the middle.
    - *d^1*. Apex of triangular elevation connected by a longitudinal carina with posterior margin of median segment...... **G. triangulifer** Kieff.
    - *d^2*. Triangular elevation longer, not connected by a longitudinal carina with posterior margin of median segment.... **G. triangulus** sp. nov.

Goniozus manilensis sp. nov.

Male.—Black, smooth, shining. Antennæ, mandibles, tibiæ, and tarsi yellow. Median segment bordered laterally by a fine carina, scarcely visibly marginate posteriorly, rather flat, without elevation in the middle. Wing subhyaline, prostigma and pterostigma brown, radial yellow, the other veins very pale; branch of basal much nearer to subcostal than to medial. Otherwise like *G. depressus*.

Length, 2.5 millimeters.

LUZON, Laguna, Los Baños.

Goniozus triangulus sp. nov.

Female.—Black. Mandibles, antennæ, trochanters, knees, tibiæ, and tarsi yellow, femora brown. Clypeus pointed in front, strongly keeled, the keel continued on forehead. Mandible lineal, with short teeth on the end. Joints of flagellum almost globular, distally gradually becoming thinner. Head nearly transverse, smooth and shining, like pronotum, mesonotum, and scutellum; eye three times as long as occiput. Posterior ocelli touching posterior margin of head.

Scutellum with a puncture in each anterior angle; median segment with an inverted-triangular, raised area, and shaped as in *G. triangulifer*, although in this species the raised area is much longer, reaching almost to the posterior margin of median segment and not connecting with the latter by a longitudinal carina. Wings rather hyaline, prostigma and pterostigma brown, veins pale. Abdomen behind with a style from which projects the ovipositor.

Length, 3.5 millimeters.

LUZON, Laguna, Mount Maquiling.

SCELIONIDÆ

The new species belonging to this family have been described.[3] The list follows:

SCELIONINÆ

1. *Heptascelio lugens* g. et sp. nov., female. LUZON, Mount Maquiling.
2. *Scelio cellularis* sp. nov., male. LUZON, Mount Maquiling.
3. *Scelio variipennis* sp. nov., male and female. MINDANAO, Dapitan. LUZON, Los Baños.
4. *Scelio facialis* sp. nov., male. MINDANAO, Iligan.
5. *Scelio xanthopus* sp. nov., female. LUZON, Mount Maquiling.
6. *Scelio microcerus* sp. nov., male. NEGROS, Cuernos Mountains.
7. *Scelio macrotomus* sp. nov., male. PALAWAN, Puerto Princesa.
8. *Sparasion parcepunctatus* sp. nov., female. LEYTE, Tacloban.
9. *Phaenoteleia rufa* g. et sp. nov., female. MINDANAO, Butuan.
10. *Camptoteleia bifurcata* sp. nov., male and female. MINDANAO, Butuan.
11. *Camptoteleia marginalis* sp. nov., male. PALAWAN, Puerto Princesa.
12. *Camptoteleia dorsalis* sp. nov., male. MINDANAO, Butuan.
13. *Camptoteleia consobrina* sp. nov., female. MINDANAO, Butuan.
14. *Camptoteleia crassicornis* sp. nov., male. LUZON, Mount Maquiling.
15. *Camptoteleia brevinervis* sp. nov., male. MINDANAO, Butuan.
16. *Camptoteleia frontalis* sp. nov., male. MINDANAO, Butuan.
17. *Camptoteleia spinosiceps* sp. nov., female. LUZON, Mount Maquiling. Possibly a new genus.
18. *Trichanteris acutiventris* sp. nov., female. LUZON, Mount Maquiling.

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[3] Broteria 14 (1916) fasc. I, III; 15 (1917) fasc. I.

19. *Psilanteris atriclava* sp. nov., female. LUZON, Mount Maquiling.
20. *Dilapitha variipennis* sp. nov., male. MINDANAO, Butuan.
21. *Chrestoteleia scapularis* sp. nov., female. MINDANAO, Butuan.
22. *Chrestoteleia impressa* sp. nov., male and female. LUZON, Mount Maquiling and Pagsanhan. PALAWAN, Puerto Princesa.
23. *Phaedroteleia armata* g. et sp. nov., male. LUZON, Mount Maquiling.
24. *Phaedroteleia ruficoxa* sp. nov., male. MINDANAO, Butuan.
25. *Styloteleia rufescens* g. et sp. nov., male and female. LUZON, Mount Maquiling.
26. *Plagioscelio rufescens* g. et sp. nov., male. MINDANAO, Butuan.
27. *Plagioscelio fuscus* sp. nov., male. MINDANAO, Butuan.
28. *Tomoteleia trifasciata* g. et sp. nov., male. LUZON, Mount Maquiling.
29. *Mesoteleia pallida* g. et sp. nov., female. LUZON, Mount Maquiling.
30. *Trissoscelio nigriceps* g. et sp. nov., female. LUZON, Mount Maquiling.
31. *Trissoscelio ruficeps* sp. nov., female. LUZON, Mount Maquiling.
32. *Trissoscelio punctaticeps* sp. nov., male. LUZON, Los Baños.
33. *Macroteleia lambertoni* sp. nov., female. LUZON, Mount Banahao.
34. *Macroteleia liebeli* sp. nov., male. LUZON, Mount Banahao.
35. *Macroteleia antennalis* sp. nov., male. PALAWAN, Puerto Princesa.
36. *Macroteleia punctatifrons* sp. nov., male and female. LUZON, Mount Banahao, Malinao, Tayabas, Los Baños. NEGROS, Cuernos Mountains.
37. *Alloteleia appendiculata* g. et sp. nov., male. LUZON, Los Baños.

TELEASINÆ

38. *Trimorus luzonicus* sp. nov., male. LUZON, Mount Maquiling.
39. *Hoplogryon* (*Allogryon*) *luzonicus* sp. nov., male. LUZON, Mount Maquiling.

PLATYGASTERINÆ

40. *Sacespalus rugosiceps* g. et sp. nov. LUZON, Mount Maquiling.

IDENTIFICATION OF AMBERGRIS

By Howard Irving Cole

Chemist, Bureau of Science, Manila

Ambergris, a biliary concretion from the intestines of the spermaceti whale (*Physetes macrocephales*), is found sometimes in the mammal itself but more often floating upon the sea or in the sand on the seacoast. It occurs in lumps varying from a few ounces to 200 pounds. The substance is of a solid waxy nature, mottled dull gray to black, and possesses a peculiar earthy odor. It adheres like wax to the edge of a knife with which it is scraped, retains the impression of the nails, and emits a fat, odoriferous liquid on being penetrated with a hot needle. The specific gravity of ambergris varies from 0.780 to 0.926. It is said to melt at 62° C. It is soluble in ether and in the volatile and fixed oils.

The composition of ambergris was investigated by Pelletier and Caventou in 1820. They found that the principal constituent was a substance to which they gave the name ambraine or ambrein. The analytical values of ambrein were not published by Pelletier until 1832 when they were given as follows: Carbon, 81.74 per cent; hydrogen, 13.32 per cent; oxygen, 4.94 per cent.

In 1912 Joseph Riban [1] investigated ambrein more closely. He had come into possession of a small quantity of ambrein which in the course of time had separated out from the alcoholic liquid in a bottle intended for extract of ambergris. The substance, after being recrystallized from alcohol, melted at between 82° and 86° C. It is a white crystalline solid separating from its alcoholic solution in slender needles. Combustion showed it to possess the formula $C_{23}H_{40}O$. The compound tends to remain in the superfused state when melted, even if sown with crystals. When warm and dry it becomes highly electrified on slight rubbing. It is not optically active, has a neutral reaction, and is insoluble in water but soluble in most organic solvents. When acted on by bromine in carbon tetrachloride solution it gives an octobromo-derivative $C_{23}H_{32}OBr_8$, a white vitreous solid. Chlorine under similar conditions decomposes it. On warming ambrein with phosphorus pentachloride, a white amorphous mass of pentachloro ambrein $C_{23}H_{35}OCl_5$ is obtained.

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[1] Compt. Rend. 154 (1912) 1729–1732; Bull. Soc. Chim. IV 11 (1912) 754–757.

The physical constants of ambergris as given in the literature vary widely. No chemical methods for its identification could be found in the literature available. The Chinese test its purity by scraping it upon boiling tea in which it should dissolve.

SUPPOSED AMBERGRIS

A number of substances suspected of being ambergris have been submitted to the Bureau of Science for identification, but one in particular is so generally considered to be the genuine article as to deserve the name "supposed ambergris." This substance is usually found floating far out at sea in localities known to have yielded ambergris. It is picked up by fishermen and sold to the Chinese and Moros as ambergris. It has been shipped through the Custom House of Manila to Japan rated as "ambergris" and is used by the natives for medicinal purposes and by the Chinese and Moros probably as an aphrodisiac. In all physical appearances it closely resembles ambergris. It occurs in the same places, is found in the same quantities, and has approximately the same specific gravity and a similar mottled appearance. It, however, has a slightly different odor and becomes brittle on ageing, while true ambergris apparently does not. Since no methods of identifying it positively as ambergris were available the matter was referred to the Bureau of Chemistry at Washington. That bureau reported that "there are no satisfactory methods by which it is possible to identify ambergris. Perfumers are in a better position to determine the genuineness of this material than we would be by ordinary analytical methods."

It seems therefore that ambergris is determined in a manner analogous to that of a good wine; that is, it is judged by a connoisseur, one who recognizes it by general appearance, bouquet or odor, etc., from a physical rather than from a chemical or microscopical standpoint.

Samples of the substance were sent to the leading perfumers of the United States and Europe with the request that an opinion be rendered as to whether the material was true ambergris. The replies were almost unanimous against the substance being ambergris. At this point the facts were brought to the attention of the writer. It seems that ambergris often contains "the horny gills of a cuttlefish species" [2] which serves as food for the whale. A careful microscopical examination proved the absence of such horny material but led to the finding of occluded fragments of moss, leaves, and bark, so distributed as to suggest inclusion in the formation of the substance rather than foreign material gathered up after the lumps were formed. This naturally indicated a vegetable rather than an animal origin. A comparison with the samples of gums and resins at the Bureau of Forestry showed the substance to have a close physical resemblance to the latex from *Artocarpus elastica.*[3]

Some of the physical and chemical constants of this latex and of the supposed ambergris were determined. The results are listed in Table 1. The known constants of true ambergris are given for comparison.

From the data given above and the microscopical examination we are led to the conclusion that the various samples of "supposed ambergris" submitted to the Bureau of Science are neither ambergris nor of animal origin, but that they are originally derived from a tree probably closely related to *Artocarpus elastica.*

TRUE AMBERGRIS

Recently a substance found in southern Palawan, near Balabac, by a Moro, was submitted to the Bureau of Science for analysis. It proved to be true ambergris.[4] The material was of a waxy nature, brown with tiny specks of white distributed through it, and there were also embedded in it many fragments of the chitinous part of the internal shell or gladius of a cuttlefish. Other chitinous fragments, in the form of a parrot's beak, and the remains of the mandibles of the cuttlefish were also found. This chitinous material is probably identical with the "horny gills of a cuttlefish species" referred to earlier in this article. These fragments appear as thin, dark brown, opaque, finely striated pieces of chitin varying in thickness from 0.04 to 0.1 millimeter. No moss, bark, or other vegetable material was found in the sample.

The specific gravity of the ambergris was 0.834. The melting point was 65° C. The ash content was 0.21 per cent. After the

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[2] Bruff, Chem. Abstr. 10 (1916) 1405.

[3] Philippine Resins, Gums, Seed Oils, and Essential Oils, Bull. P. I. Bur. Forestry No. 20 (1920) 68.

[4] This lot of ambergris weighed 47 kilograms.

TABLE 1.—*Comparison of true ambergris, "supposed ambergris," and latex from Artocarpus elastica.*

Substance.	Color.	Texture.	Odor.		Melting point.	
			Natural.	On burning.	Substance.	Ether extract.
True ambergris	Yellow-green to brownish black.	Waxy	Earthy	Odor of burning fæces.	65° C.[a]	82° to 88° C. (ambrein).
"Supposed ambergris."	Mottled gray to yellow.	Chewing-gum texture; yellow part is hard and brittle.	Mixture of odor of brown sugar and new sawdust.	Burning rubber odor	Softens at 100° C.; melts at 112° C.	Softens at 100° C.; melts at 120° C.
Latex from *Artocarpus elastica.*	Gray	Chewing-gum texture; some parts hard and brittle.	New sawdust odor	do	Softens at 100° C.; melts at 131° C.	Softens at 100° C.; melts at 118° C.

Substance.	Specific gravity.	Ether extract.		Ash.	Gutta.
		Saponification No.	Iodine No.		
					Per cent.
True ambergris	0.908 to 1.5028	17 to 35	78	Traces[b] 6 per cent.[c]	
"Supposed ambergris"	Variable; gray, over 1.000; yellow, less than 1.000	109.4 to 121.4	52.9 to 78.54	3.6 per cent	[d] 21.06
Latex from *Artocarpus elastica*	Variable; approximately 0.950	92.50	100.17	0.54 per cent	[d] 10.00

[a] Determined in the Bureau of Science. 60° C. is stated by Bruff, Chem. Abstr. **10** (1916) 1405, to be the melting point.

[b] Bruff, loc. cit.

[c] Jacob Lund, Chem. Abstr. **12** (1918) 773.

[d] Determined by method given in Allen's Commercial Organic Analysis 4th ed. **4**: 160. The sample of supposed ambergris was carefully selected to exclude all the brittle yellow substance. The only sample of *Artocarpus elastica* available had, however, become almost entirely crumbly (oxidized), so the gutta content is naturally low.

ambergris was melted, it remained as a brownish black viscous mass on cooling.

Attempts to crystallize the ambrein from alcohol were unsuccessful. No crystallizable product could be obtained upon acetylization with acetic anhydride.

The above data and especially the microscopical examination proved that this substance was true ambergris.

CONCLUSION

A careful microscopical examination of substances suspected of being ambergris will often prove to be of greater value in the identification of such substances than the ordinary physical or chemical methods.

NEW MALAYAN CIXIIDÆ (HOMOPTERA)

By F. Muir

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TWO PLATES

The three genera dealt with in this paper all possess a well-developed subantennal process in the shape of a keel across the gena. In this they differ from *Myndus* and allied genera. Measurements are from the apex of vertex to anus and from the apex to base of the tegmen. The types are deposited in the Hawaiian Sugar Planters' Experiment Station collection, and they bear the type numbers of that collection; the paratypes are in Prof. C. F. Baker's collection.

Genus **KINNARA** Distant, Plate 1, fig. 1

Pleroma Melichar, Hom. Fauna Ceylon (1913) 41, pl. 1, figs. 12, *a–c*, nom. praeoc.; Bierman, Notes Leyden Mus. 29 (1908) 154, pl. 3, fig. 3.

Kinnara Distant, Fauna Brit. India, Rhynchota 3 (1906) 289; 6 (1916) 59; Muir, Proc. Haw. Ent. Soc. 2^5 (1913) 265.

The genus *Kinnara* Distant is of interest as it combines characters of both the Cixiidæ and the Achilidæ. The claval veins are fairly thick and fork near the apex of clavus; in some species they end at the apex of the clavus, in others they join the suture a little before the apex. The tegmina are tectiform or subtectiform, the hind margins are not greatly produced beyond the clavus and do not overlap when at rest. The median ocellus is present in all the species that I have examined.

In the female the genital styles are very short and do not form a complete ovipositor, a condition found in the Achilidæ. The posterior abdominal tergites of the female are mostly membranous, flattened, and form a large wax-secreting area. The male pygofer is flattened laterally and is cixiidlike in construction. There is a lateral appendage on each side which arises near the base of the genital styles and is more or less connected with the sides of the pygofer. The ædeagus is complex, with a long, semimembranous, curled tube at the apex.

Until we have a greater knowledge of the morphology of the Cixiidæ and Achilidæ, I think it is best to place all fulgorids with a median ocellus in the Cixiidæ. In *Kinnara* other characters indicate that family as the best locality in which to place this genus.

In considering the venation I have concluded that R touches M for a short distance (Plate 1, fig. 1). Only a study of the tracheation of the wing pad will settle this point beyond doubt.

This genus has a distinct subantennal flange and a smaller one at a right angle to it beneath the antenna.

Kinnara spectra Dist. Plate 1, fig. 2.

Kinnara spectra DISTANT, Fauna Brit. India, Rhynchota 6 (1916) 60.

One male and one female from Singapore agree with the description, which contains no mention as to sex or genitalia.

The lateral process on the male pygofer is long, subspatulate and subtruncate at apex; slightly dorsad of this process the margin is produced into a squarish process with the apex oblique. Anal segment large with rounded apex and concave on the ventral surface. The genital styles are subtriangular with the longest side forming the outer margin, which is sinuous; apex produced into two small processes, a slender, curved process and a smaller process. Ædeagus complex.

Anterior genital style of female subtriangular, width of base about half the length, apex rounded with a small notch slightly before apex; a transverse ridge across the base.

A comparison of these genitalia with those of the Indian specimens is necessary to confirm this identification.

Kinnara flavofasciata Dist. Plate 1, fig. 3.

Kinnara flavofasciata DISTANT, Fauna Brit. India, Rhynchota 6 (1916) 59.

Four males from Basilan and one female from Zamboanga, Mindanao, Philippine Islands (*Baker 13353*), I refer to this species until the genitalia of the Indian specimens have been examined.

In the male the lateral process of the pygofer is narrow, subequal in width to the apex which is rounded. The genital styles are narrow on basal two-thirds with subparallel sides, the apex is expanded, the outer corner produced into a beanlike process, the inner corner rounded.

Kinnara penangensis sp. nov. Plate 1, fig. 4.

Female.—Length, 3.5 millimeters; tegmen, 5.4. Stramineous; mesonotum slightly darker. Tegmina hyaline, slightly stramineous, a faint fuscous band across from stigma to apex of clavus, veins stramineous. Wings hyaline, veins yellowish. Vertex about square; carinæ on mesonotum obsolete. Anal segment small, not reaching apex of genital styles. Anterior genital style triangular, length about one and one-half times the width of base with a small notch at apex on the inner side.

Penang Island (*Baker*), 1 female. Type No. 1032.

Kinnara nigrolineata sp. nov. Plate 1, fig. 5.

Male.—Length, 2 millimeters; tegmen, 3.5. Only three apical median veins, M_2 lacking; claval vein joining suture slightly before apex. Vertex wider than long. Lateral appendages of pygofer long, narrow, curved, and recurved, apex bluntly rounded. Genital styles small, narrow, inner margin slightly curved, outer margin slightly sinuate, apex truncate, outer angle produced into an acute point. Light stramineous; brownish along carinæ of face and clypeus. Tegmina hyaline, very slightly stramineous, veins slightly darker, a dark, fuscous mark from crossvein between M and Cu in middle of tegmen to apex of M_3; wings hyaline, basal and anal areas fuscous.

NEGROS, Cuernos Mountains (*Baker*), 1 male. Type No. 1033.

Kinnara bakeri sp. nov. Plate 1, fig. 6.

Male.—Length, 1.7 millimeters; tegmen, 3. Vertex about as long as broad. The base of Sc + R joined to the base of M for a very short distance. The lateral processes of pygofer long, narrow, slightly broadened in the middle, the apex acute. Genital styles, in lateral view, strongly curved at the base, broad on basal two-thirds and tapering to acute apex. Anal segment rounded at apex. Head, legs, and lateral portion of pronotum stramineous; mesonotum and abdomen dark brown. Tegmina dark fuscous, veins fuscous, lighter clear areas around the stigma and in the apical cells. Wings fuscous with dark veins.

Female.—Length, 1.8 millimeters; tegmen, 3.3. In color similar to the male. The anterior genital styles triangular, length about one and one-half times the width of base, a small flange along the base produced into a small rounded process on the inner corner.

Singapore (*Baker 9924*), 2 males and 1 female. Type No. 1034.

This species comes near *K. brunnea* Muir, but the color is somewhat distinct and the process at the base of the anterior styles of female is not so large.

Kinnara marginalis sp. nov. Plate 1, fig. 7.

Male.—Length, 2 millimeters; tegmen, 3. Veins Sc, R, and M joined at their bases into a very short stalk. Costal cell broad, the margin all around broad, more especially along the costa. Vertex slightly wider than long. The lateral processes of pygofer narrow, long, and slightly curved. The genital styles curved, nearly straight on inner margin, outer margin concave in middle, apex rounded. Anal segment large, rounded at apex. Head, thorax, and legs stramineous or light brown, the posterior part of the mesothorax and the carinæ darker, abdomen brown. Tegmina and wings hyaline, uniformly light brown, veins darker.

BORNEO, Sandakan (*Baker 9923*), 1 male. Type No. 1035.

I have three females from Dapitan, Mindanao (*Baker*); although these are similar to *K. bakeri*, I feel sure that they will prove to be distinct when the male is known.

Genus EURYPHLEPSIA novum

Type, *E. amboinensis* sp. nov.

Tegmina comparatively narrow, subparallel-sided or slightly widened toward apex which is rounded. Margins with distinct border all around, widening out at stigma; costal cell large, Sc and R joined together to near stigma with their bases joined to M to about middle of clavus, the common base and the Sc + R thickened and joined to the stigma; forking of Cu slightly before apex of clavus. Two apical Rs, five apical Ms with the M_1 arising from M_2 in some specimens. Claval vein joining margin before apex, forking about middle, first claval vein thickened at base (Plate 1, fig. 8).

Vertex longer than wide, widest at base, which is slightly and roundly emarginate, lateral carinæ well developed, continuing unbroken on to the face, median frontal carina projecting at apex, a transverse carina about middle. Base of face about half the width of apex, apical half roundly ampliate at sides, median carina distinct to median ocellus. A distinct subantennal process across gena touching the lateral carina of face a little before apex. Clypeus large, sides flattened, lateral and median carinæ distinct. In profile median portion of face slightly protruding near apex. Antennæ short, first segment very short, second segment shorter than broad, in apical view broader than deep (Plate 2, fig. 1). Eyes slightly emarginate along ventroanterior margin. Prothorax short, hind margin widely and subangularly emarginate, posterior lateral angles acute, no distinct carinæ. Mesonotum tricarinate, slightly flattened between carinæ, hind margin forming about an equilateral triangle. Female with complete ovipositor projecting about two-thirds beyond pygofer, which forms a small, round, wax-secreting area. Posterior tibiæ unarmed.

This genus comes into the Oecleini, in which tribe the bases of Sc, R, and M form a common stalk, thus only two veins arise from the basal cell.

Euryphlepsia amboinensis sp. nov. Plate 1, fig. 8; Plate 2, figs. 1, 2.

Male.—Length, 3 millimeters; tegmen, 3.7. Ochraceous orange or ochraceous buff; slightly darker on carinæ of head and on mesonotum. Tegmina hyaline, ochraceous, veins of same color, apices of apical veins and apical crossveins brownish. Wings hyaline, with ochraceous veins. Lateral margins of pygofer produced into a small subangular projection about middle, medioventral projection conical in outline. Anal segment large and consisting of three pieces, a large basal piece produced into a small process at the sides, a small triangular middle portion and a large, lanceolate apical portion, slightly curved and concave on ventral surface. This apical portion is possibly the anal style. Genital styles large, narrow at base, widest in middle, inner margin convex, outer margin slightly sinuous, apex narrow, very slightly bilobed. Ædeagus complex.

Female.—Length, 3 millimeters; tegmen, 4. Darker than the male; in some specimens the dark markings over the apical veins and crossveins more extensive and the costal cell and clavus quite fuscous.

Described from specimens from several localities. The type consists of a male and a female from Amboina (*Muir 1036*). Among the paratypes are both light and dark females as follows: Seven dark females from Amboina and one from Piroe, Ceram (*Muir*); two males and three females from Sandakan, Borneo (*Baker 10063*), which are darker than the Amboina males; two light males and four dark females from Dapitan, Mindanao (*Baker 4413, 4415, 13349*); one dark female from Butuan, Mindanao (*Baker 10075*); one dark female from Malinao, Tayabas, Luzon (*Baker*); one light male from Kolambugan, Mindanao (*Baker 13643*); one dark female from Puerto Princesa, Palawan; one light male and four light females from Mount Maquiling, Luzon (*Baker 1323, 9350, 9364, 10068; Muir*).

This species was named and described before I found that the Ceram, Borneo, and Philippine specimens were the same.

Euryphlepsia papuaensis sp. nov. Plate 2, fig. 3.

Male.—Length, 2 millimeters; tegmen, 3. Only four median apical veins, M_4 lacking. Transverse carina of vertex obscure. Lateral margins of pygofer produced into a thin, small, acute spine in the middle, medioventral margin produced into a quadrate process longer than wide with the apex narrower than base. Anal segment truncate at apex, each apical angle produced into a long, thin, curved spine, anal style small. Genital styles small, laterally flattened, curved, apex truncate and slightly wider than base. Brown; lateral carinæ of head, labium, legs, and pronotum lighter. Tegmina hyaline, brownish, lighter in middle of apical and subapical cells. Wings hyaline, slightly fuscous, veins dark.

Female.—Length, 2.6 millimeters; tegmen, 3. Similar in color to male. Anal segment longer than broad, slightly flattened horizontally, apex truncate.

PAPUA, Laloki River (*Muir 1909*), 1 male and 4 females. Type No. 1037.

Euryphlepsia pallidifrons sp. nov. Plate 2, fig. 4.

Male.—Length, 2.7 millimeters; tegmen, 3.2. Lateral margins of pygofer produced into a small, acute spine in middle, ventral margin produced angularly in middle. Anal segment large, anus slightly before apex, each apical corner produced into a long, strong spine nearly as long as segment and, in lateral view, at right angle to segment. Genital styles large, angular near base, apex truncate, oblique, outer margin concave. Head, lateral portion of pronotum, and legs pale yellow; mesonotum and abdomen brown. Tegmina hyaline, fuscous brown, lighter on apical and preapical cells.

Female.—Length, 2.6 millimeters; tegmen, 3. In color similar to the male.

BORNEO, Sandakan (*Baker*), 1 male and 1 female. Type No. 1038.

Euryphlepsia lineata sp. nov. Plate 2, fig. 5.

Male.—Length, 3 millimeters; tegmen, 3.5. Stramineous; tegmina hyaline, stramineous, veins slightly darker, slightly fuscous over first two apical median cells and clavus. In lateral view lateral margins of pygofer slightly rounded, medioventral edge conically produced with a minute projection at each side of its base. Anal segment short, anus before apex, lateral margins at apex produced into a broad, flat angle, anal style small. Genital style small, narrow, angled and narrow in middle, apex truncate, slightly widened.

Female.—Length, 3 millimeters; tegmen, 3.8. In color similar to male but the lateral portions of the mesonotum brown and the dark color continuous over clavus and along tegmen to apical median cells. Wings hyaline with brown veins.

BORNEO, Sandakan (*Baker 10059, 10062, 10065*), 4 males and 6 females. Type No. 1039.

Euryphlepsia flava sp. nov. Plate 2, fig. 6.

Male.—Length, 2.6 millimeters; tegmen, 3.2 Yellow; tegmina hyaline, slightly flavous, veins darker. Wings hyaline, veins light. Lateral edge of pygofer slightly and subangularly produced in middle, medioventral process subconical in outline. Anal segment fairly large, anus before apex which is asymmetrically produced into a squarish process on the left side of apex. Genital styles slightly curved; broadest at apex, which is truncate.

BASILAN (*Baker*), 2 males.

Genus **STENOPHLEPSIA** novum

Type, *Stenophlepsia flava* sp. nov.

Head and thorax as in *Euryphlepsia*, the median ocellus obscure, or even lacking in some specimens. Female ovipositor complete, projecting beyond apex of abdomen. Pygofer of female forming a round, wax-bearing area. Hind tibiæ unarmed.

Sc and R forking a little before middle of tegmen, M joining Sc + R near the base. Two apical branches to R and five to M. Stigma large. Claval vein entering commissure near apex, commissure of clavus thickened; forking of claval veins about middle of clavus (Plate 2, fig. 7).

This genus differs from *Myndus* Stål in having a distinct subantennal process. It differs from *Euryphlepsia* g. nov. in having no thickening of Sc + R + M, or only at the extreme base, and M only joins Sc + R near base.

Stenophlepsia flava sp. nov. Plate 2, figs. 7, 8.

Male.—Length, 3.3 millimeters; tegmen, 4.6. Yellow; tegmina hyaline, veins stramineous, the apical portion of the apical veins and the apical crossveins fuscous; clavus between veins and commissure dark, opaque. Wings hyaline, veins brown, fuscous over anal area. Lateral margins of pygofer produced into two small, quadrate processes about the middle, medioventral margin produced into an angular process. Anal segment large, anus before apex, lateral edges near apex produced into a large process with rounded apex. Genital style flattened laterally, angular before middle, broadest at apex where it is truncate and slightly oblique.

Female.—Length, 3.4 milimeters; tegmen, 4.7. In color similar to male.

LUZON, Laguna Province, Mount Maquiling and Los Baños (*Baker 2503; Muir*), 4 males and 3 females. Type No. 1042.

Stenophlepsia fasciatipes sp. nov. Plate 2, fig. 9.

Male.—Length, 2.7 millimeters; tegmen, 3. Face, clypeus, genæ, and lateral portions of pronotum stramineous; vertex, middle of pronotum, mesonotum, and abdomen brown. Front legs with coxæ and femora dark, tibiæ light; middle femora dark, a dark band on tibiæ and on tarsi; hind tibiæ with a dark band about middle, another at apex and base of basitarsus and another small band on second and third segments of tarsi. Tegmina dark brown with lighter marks in apical portion of apical cells. Wings fuscous, veins dark. Middle of lateral margins of pygofer produced into a small, subquadrate process, ventral edge in middle produced into a subtriangular process. Anal segment fairly short, apex rounded, not produced. Genital styles curved, gradually widened to apex which is round.

Female.—Length, 3 millimeters; tegmen, 3.4. Similar in color to male.

MINDANAO, Davao, 1 male. BASILAN (*Baker 13641*), 1 female. Type No. 1043.

Stenophlepsia brunnea sp. nov. Plate 2, fig. 10.

The base of Sc + R is slightly thickened but M does not join them till near the base. I therefore include it in this genus.

Male.—Length, 2.7 millimeters; tegmen, 3. Head, legs, and pronotum stramineous, mesonotum and abdomen brown. Tegmina hyaline, brown, veins dark, small light spots in the middle of subapical and apical cells. Wings hyaline, fuscous, veins dark. Lateral margins of pygofer slightly angular in middle, medioventral margin produced into an angular process. Anal segment small, anus before apex, apex asymmetrical, the left side being produced into a subquadrate process; anal style small. Genital styles very thin, long, slightly curved, apex rounded.

Female.—Length, 2.7 millimeters; tegmen, 3. In color similar to male but slightly darker.

LUZON, Laguna Province, Mount Maquiling and Los Baños (*Baker 10069; Muir*), 2 males and 5 females. Type No. 1040.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Kinnara* Distant, left tegmen.
2. *Kinnara spectra* Distant, lateral view of male genitalia.
3. *Kinnara flavofasciata* Distant, lateral view of lower portion of male pygofer and left style.
4. *Kinnara penangensis* sp. nov., right anterior style of female.
5. *Kinnara nigrolineata* sp. nov., lateral view of lower portion of male pygofer and left style.
6. *Kinnara bakeri* sp. nov., lateral view of male genitalia.
7. *Kinnara marginalis* sp. nov., lateral view of lower portion of male pygofer and left style.
8. *Euryphlepsia amboinensis* sp. nov., left tegmen.

PLATE 2

FIG. 1. *Euryphlepsia amboinensis* sp. nov., lateral and front view of head.
2. *Euryphlepsia amboinensis* sp. nov., lateral view of male genitalia.
3. *Euryphlepsia papuaensis* sp. nov., lateral view of male genitalia.
4. *Euryphlepsia pallidifrons* sp. nov., lateral view of male genitalia.
5. *Euryphlepsia lineata* sp. nov., lateral view of male genitalia.
6. *Euryphlepsia flava* sp. nov., lateral view of male genitalia.
7. *Stenophlepsia flava* sp. nov., right tegmen.
8. *Stenophlepsia flava* sp. nov., lateral view of male genitalia.
9. *Stenophlepsia fasciatipes* sp. nov., lateral view of male genitalia.
10. *Stenophlepsia brunnea* sp. nov., lateral view of male genitalia.

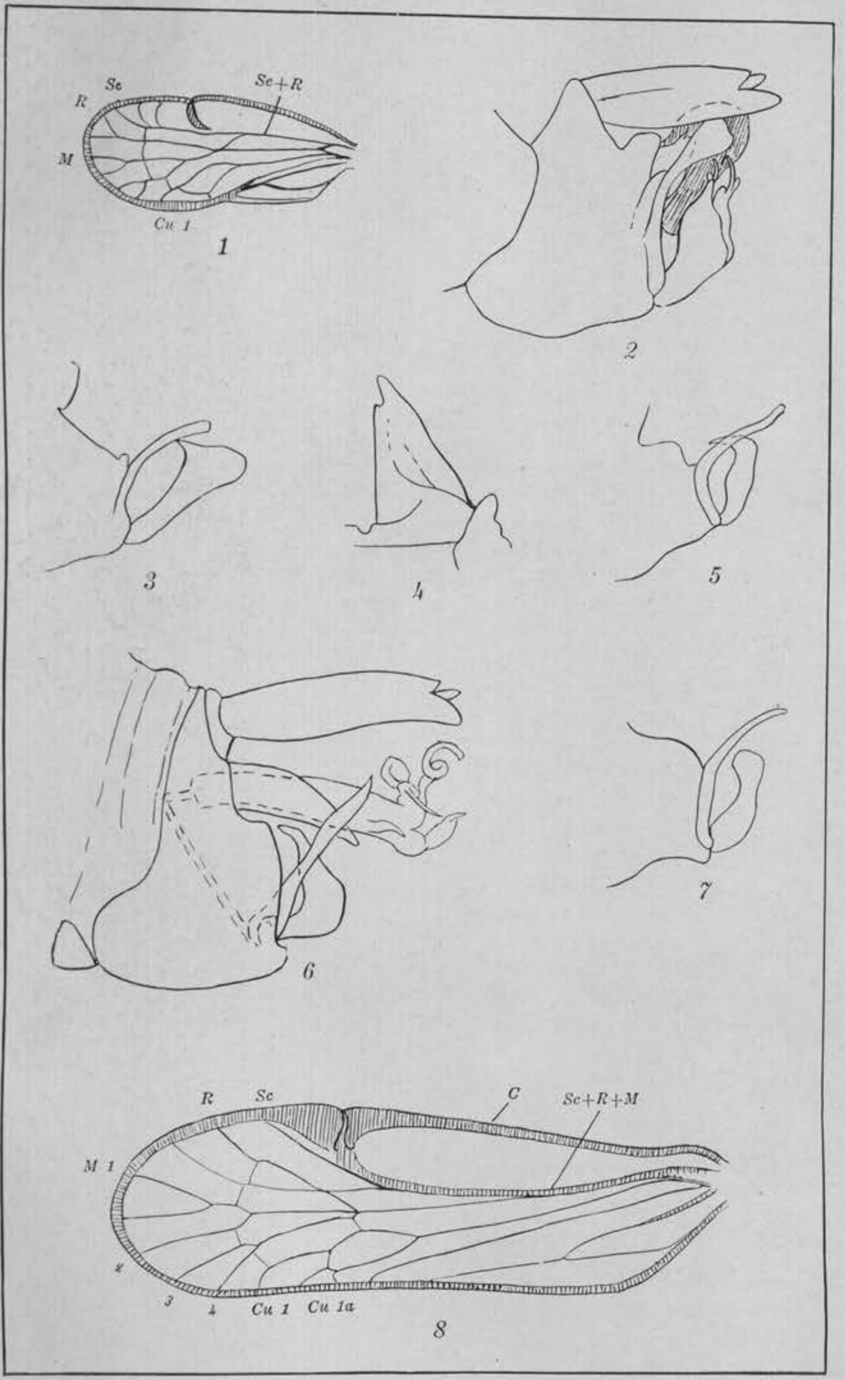

PLATE 1. NEW MALAYAN CIXIIDÆ.

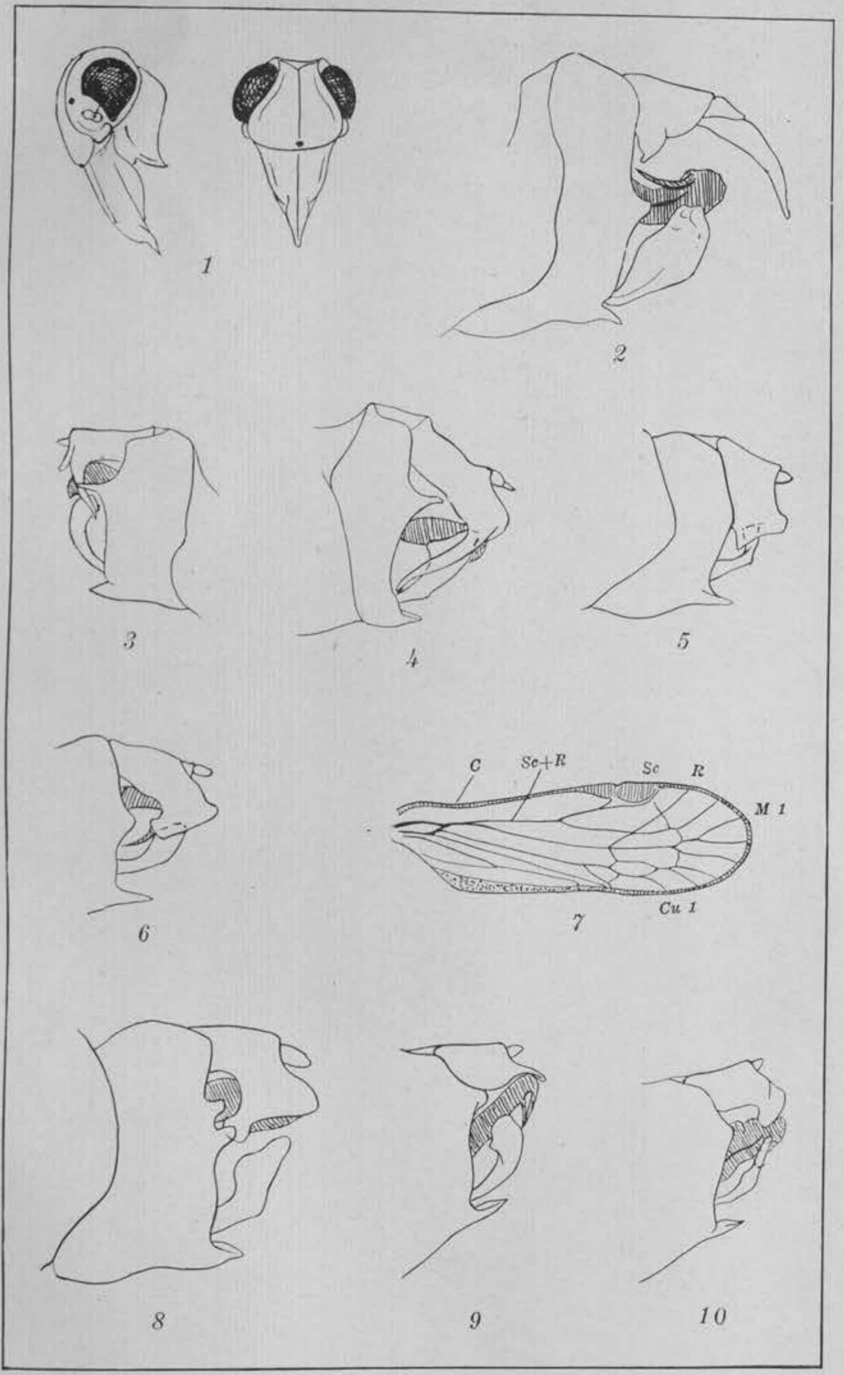

PLATE 2. NEW MALAYAN CIXIIDÆ.

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